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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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American Foundry Conditions.

Mr. J. T. Kay, a moulder employed by the Parkinson Stove Company, Limited, of Birmingham, has recently returned from America, which country he visited as a member of the "Daily Mail's" Trade Union Mission. He has embodied his conclusions in a report, an abstract of which we publish elsewhere. The object of the Mission was to discover why American industrialists pay high wages to the workmen. Several members of the Mission state that American employers start off by offering high wages and insisting that they get good value for their money. Unlike any other country in the world, America is practically untrammelled by foreign competition. It enjoys a home market, the filling of which is sufficiently large a problem to fire the imagination of the most enthusiastic devotee of quantity production, and to warrant the interest of even the largest group of financiers.

Mr. Kay, in his very well thought out report, comments on the high buying capacity of American workmen, and co-relates this with the co-operation which exists between master and man for the maintenance of high production. One member of the Mission—not Mr. Kay—insisted that the key of the whole situation was "Pay your men well and they will make your plant pay." Under existing trade union conditions we are afraid this is impossible. If it were done nationally, then the engineering industry would be following in the steps of the mining industry in asking for a Government subsidy. If individual firms attempt it, they will be in competition with the "man next door" paying "trade union" wages.

Mr. Kay, like most of the other members, stresses that the American employer is ready to scrap any plant if better can be found. We have constantly urged that whilst trade has been so depressed to plan extensions, improvements and alterations in such a way that when conditions allow, such alterations can be expeditiously put into effect, and this without being overloaded with the question of design when one has but little time to deal with it.

It should be borne in mind that Britain pays the highest wages in Europe, and is obviously in competition with those countries paying lower wages. Britain is part of an enormous commonwealth of nations, the buying capacity of which is but second only to America. If the requirements of these can be somewhat unified then factors would be instituted similar to those existing in the States, and a higher standard of living assured.

A comparison between Great Britain and America reveals that under weak trade union conditions the latter has given the highest standard of living to its operatives the world has ever known, whilst the former, which has a power second only to that possessed by the Government itself, enjoys the highest standard of living in Europe. It can thus be deduced that trade unionism has no influence whatsoever upon the standard of living prevalent in any one country. Rather must one look to such factors as natural resources, rate of development, and the capacity of the markets available to it. Perhaps Britain has made the mistake of writing down the value of buildings, plant and goodwill to vanishing point, without a realisation that even a zero figure may be too high, and that the buildings and machinery may be of such a character as to be a handicap to production.

XUM

Effect of Oxygen Purity on Oxy-Acetylene Cutting.

Developments which have been achieved by the British Oxygen Company, Limited, in the direction of producing oxygen from the air, following the demand which has arisen for the purest gas for metal-cutting and welding purposes, were described in a Paper read before the British Acetylene and Welding Association recently by Mr. C. R. Houseman. Three years ago the Company carried out cutting experiments on 2-in. steel plates, with oxygen of 98.5 and 99 per cent. purity, and satisfied themselves that even the small difference of 0.5 per cent. in the purity made an appreciable difference in the cutting. These conclusions have been amply confirmed and extended by a very comprehensive series of experiments undertaken by the Air Reduction Company of America. Qualities of oxygen ranging from 97.5 to 99.5 per cent. and advancing by increments of 0.25 per cent. were tested on a large variety of steel plates, and under identical conditions in every instance, except as regards pressure. It was found that, as the oxygen quality diminished, the pressure had to be increased, and as the same size of cutting nozzle was used for each quality of oxygen, this meant a proportionate increase in the quantity used. It also meant a longer time for cutting the same length of plate, and a relatively inferior quality of cut. The lower the pressure at which the oxygen-cutting can be effected, the cleaner and better the cut, and low-quality oxygen generally reveals itself in the roughness of the lower section of the kerf, and also by a fringe of partly-burned metal on the lower edge, where the final severance of the plate takes place.

There is nothing mysterious about this effect, if the composition of the cutting jet of oxygen is considered, from the time it impinges on the plate until it finally issues at the bottom of the kerf. Since argon, an inert gas, would not be removed from the gaseous phase by chemical combination, it follows that its proportion must increase progressively as the cutting jet descends the kerf, oxygen being rapidly removed with iron as molten oxide. Argon is the impurity present in oxygen gained from the air by the liquefaction process. Gas of 98 per cent. quality contains practically no nitrogen, and even at 96 per cent. there is still very little nitrogen. With electrolytic oxygen the impurity is hydrogen, and this likewise remains in the gaseous phase at the temperatures involved, either as unchanged hydrogen or in combination with oxygen in the form of an equal volume of steam. Whether argon or hydrogen, the diluting effect is much the same. It is because of this cumulative diluting effect that relatively small percentages of impurity in oxygen, which would be entirely negligible in oxy-acetylene welding, are quite appreciably detrimental in cutting.

Before the end of this year the British Oxygen Company hope to be in a position to guarantee a uniform standard quality of at least 99.5 per cent. at all their oxygen factories. Also, they believe that they will be able shortly to supply oxygen still purer.

The Surtees Medallists.

We have pleasure in reproducing below the portraits of Mr. John G. Arnott and Mr. Allan S. Meikle, who respectively gained the Gold and Silver Medals which are awarded biennially under a deed of gift made by the late Mr. Mayer, a Past-President of the Institute of British Foundrymen. Mr. Arnott served his apprenticeship at the works of Messrs. G. & J. Weir, Cathcart, where the training scheme is designed to give a thorough training in general engineering as well as in foundry work. Before passing into the foundries where he is now employed, Mr. Arnott had experience of machinery, fitting and patternmaking. Mr. Meikle was trained at Allan Glen's School, and is serving his apprenticeship with Messrs. Hydepark & Gowanbank Foundry Company, Glasgow. He has recently completed the metallurgical course at the Royal Technical College, Glasgow.

Mr. James G. Arnott.
Surtees Gold Medallist.

Mr. Allan S. Meikle.
Surtees Silver Medallist.

Foundry Query.

Cracks in Steel Ingots.

As a representative of Ford Motor Company, who are trying to eliminate cracks in 15-cwt. steel ingots, I would greatly appreciate any information in that direction.

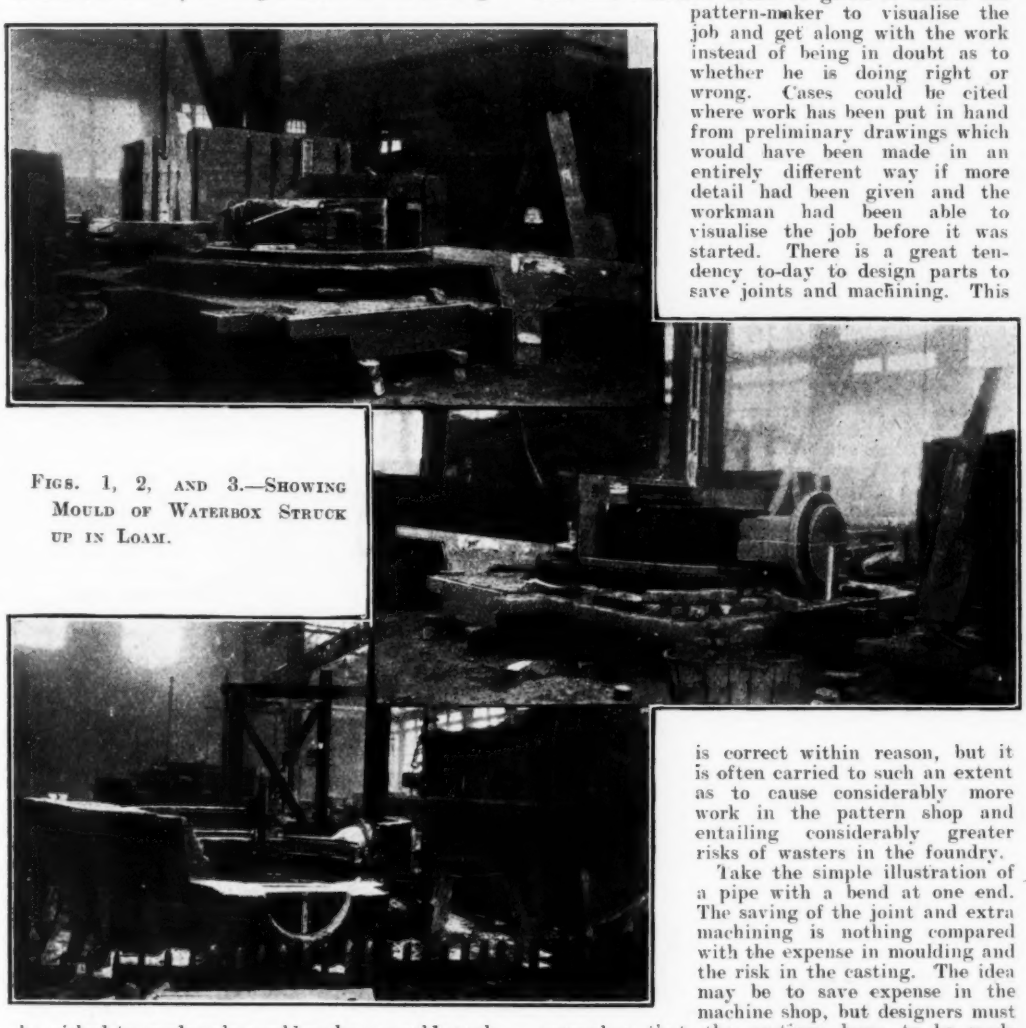
R. E. Gatts,
2,636, Carson Street, Detroit, Mich.

[We are afraid the information is rather too meagre to enable us either to diagnose the cause or suggest remedies with any degree of certainty. It is seldom that any trouble is experienced with plain low or medium carbon steels, but it is occasionally encountered when making high carbon or alloy steels, especially the nickel-chrome variety. Stripping too quickly is one cause, cold ingot moulds a second, and a bad surface on the ingot mould a third. Another cause is casting at too high a temperature.—Editor.]

Pattern-Making and its Relation to Design and Foundry Practice.*

By R. W. Kemlo.

Though pattern-making as a trade in itself may be a comparatively recent introduction it is actually of great antiquity. Pre-historic man after discovering the molten metal in his fire, then finding that it could be worked into shape by hammering, eventually found that it could be run into moulds and the desired shapes obtained without so much hard labour. There is much evidence that moulds were carved from stone, and no doubt many were modelled in clay by hand without the aid of a pattern, but probably it would not take long for our pre-historic forebears to find out that by making a model of the casting he wished to produce he could make a mould much more readily.



FIGS. 1, 2, AND 3.—SHOWING MOULD OF WATERBOX STRUCK UP IN LOAM.

Various materials have been used for making patterns, and no doubt pre-historic men made their early patterns in clay. In later periods wax has played a prominent part in the making of the models used, and it is well known how the moulds were made around the wax models, then placed in ovens and the wax melted out of the mould leaving the space for the metal to run into. This class of pattern was, of course, useless for repetition work.

Although the present-day pattern-maker is a specialist, he must have a sound general knowledge of engineering, he must understand the principles and method of moulding, machining and fitting together of the parts he has to make.

* A paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. S. G. Smith presiding. The Author is associated with Metropolitan Vickers, Limited.

Relations with Drawing Office and Foundry.

This relationship is very important. Machines with machine parts are often designed by men who give very little thought as to how the parts will subsequently be made. In the rush of modern practice, the draughtsman is often called upon to give preliminary drawings to enable the pattern shop to start. One of the first essentials in the pattern shop is plain, readable drawings, but often these preliminaries are so faint that it is difficult to distinguish either lines or figures, and errors are liable to creep in where least expected. Preliminary drawings should be easily read and sufficient detail be given to enable the pattern-maker to visualise the job and get along with the work instead of being in doubt as to whether he is doing right or wrong. Cases could be cited where work has been put in hand from preliminary drawings which would have been made in an entirely different way if more detail had been given and the workman had been able to visualise the job before it was started. There is a great tendency to-day to design parts to save joints and machining. This is correct within reason, but it is often carried to such an extent as to cause considerably more work in the pattern shop and entailing considerably greater risks of wasters in the foundry.

Take the simple illustration of a pipe with a bend at one end. The saving of the joint and extra machining is nothing compared with the expense in moulding and the risk in the casting. The idea may be to save expense in the machine shop, but designers must remember that the castings have to be made by the foundry and a scrap casting may cost much more than a number of machining operations. At the same time it is not claimed that the foundry can ignore the demands of the engineers altogether, for if they can show any advancement in engineering science and the cheapening of production, the foundry must do its share to meet these requirements. The drawing office could give more attention to designs where stresses are set up in the casting, due to thick and thin sections coming in close proximity. If the heavy portions are adjacent to thin ones and there is no possibility of feeding thick section save through the thin one, pulls and tears and internal cavities are inevitable. Many castings are so designed that there is no chance of efficiently feeding heavy sections. It is not always possible to avoid this, but it should be

taken care of whenever possible. Draughtsmen should make it part of their business to find out all they can about how castings are made, as this would tend to greater simplicity in design. Although the pattern shop can generally find a way out and transfer a pattern into the foundry so that castings can be produced, the cost of that production may be a high one, whereas if the designer had known of the difficulties to be contended with he might have designed something simpler, but just as effective, which could be produced much cheaper. Sometimes a little has to be sacrificed for appearance sake, but there is no doubt that if the draughtsman knew more about moulding methods, some of the pocketed and jagged design would disappear with beneficial results to everybody.

The relationship between the pattern shop and the foundry should be such that free and open discussion should be possible when any question is in doubt. With the majority of jobs it is not necessary to call upon the moulder for his decision, the usual foundry practice being applicable, but the pattern-maker has carefully to examine the drawings and decide how the patterns must be made, taking into consideration that as the pattern is actually a tool provided for the moulder it must be made in such a manner as to facilitate the production of the casting. The method decided upon from the study of the drawing is of the utmost importance as the foundry will eventually suffer from any error of judgment at this point, so that it is here that in cases of complicated design the moulder should be brought in. He knows the conditions under which he has to work and he should know what tackle he has to use. Here inconsistencies in design may be corrected and modifications made which will simplify the work both in the pattern shop and the foundry. Unfortunately, it is often found that the moulder will not care to give his decision until he sees the pattern taking shape, but the proper time to say how a pattern should be made is before it is started and not after it is complete, and the failure of moulders to read a drawing or to visualise a job is a great disadvantage. This does not throw any reflection on the moulder as a craftsman, but it would be to his advantage and enable him to take the place he should hold in the engineering industry if he were able to discuss a job right from the drawing board. Patterns made to suit one foundry do not always meet with the approval of another, and cases are known where patterns which have been made to suit one man and worked successfully have had to be altered when given to another man in the same shop.

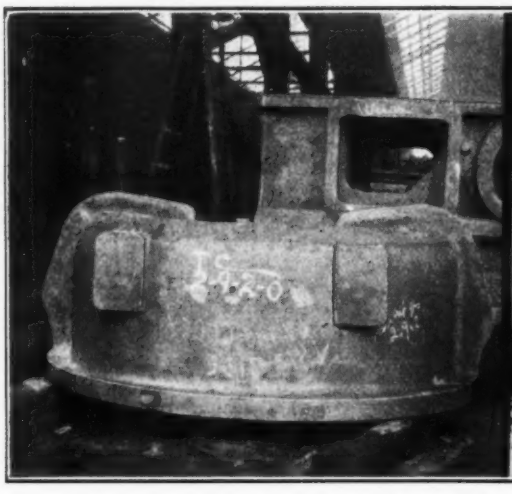


Fig. 4.—Casting of Part of a Turbine.

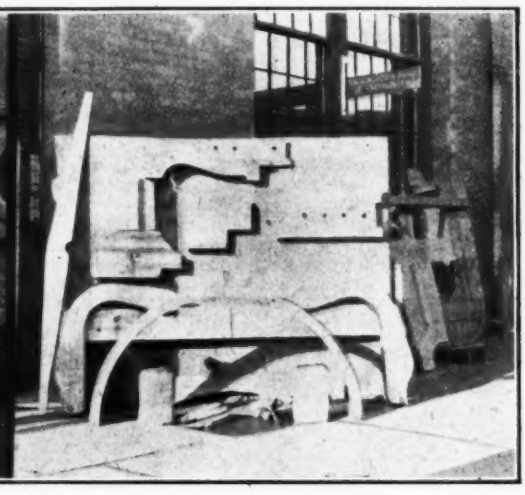


Fig. 5.—Showing Pattern-making required to Produce the Casting shown in Fig. 4.

Contraction Allowances.

Shrinkage or contraction causes much trouble to the pattern-maker and moulder, and at times is difficult to deal with. The average contractions for cast iron in cooling is about 1/10-in. to the foot, cast steel about 7/32-in., brass and malleable iron approximately the same as steel, but the contraction of castings varies with different factors such as the mixture of the metal, casting temperatures, the different rate of cooling, the thickness of the casting and the general design of the casting. Castings of thin section cool quicker and contract more than thick ones. It is this difference in cooling that so often causes trouble in the case of castings of unequal thickness. Large and heavy castings will contract less than thin ones and the presence of cores in castings of box sections will prevent contraction. In making his allowances, the pattern-maker has often to use his judgment working on past experience on similar classes of work. Unfortunately, he sometimes finds himself in

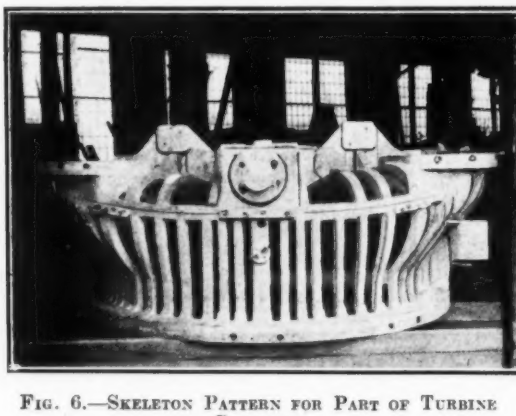


Fig. 6.—Skeleton Pattern for Part of Turbine Cylinder.

Fig. 7.—Shows the Casting made from a Skeleton Pattern.

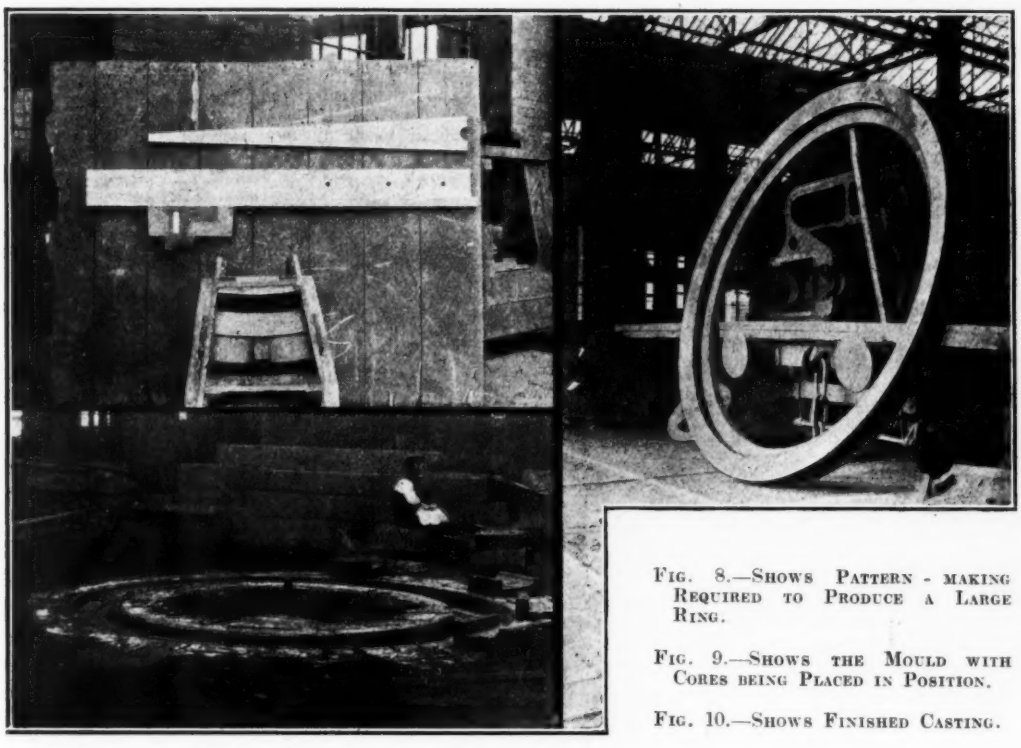


Fig. 8.—Shows Pattern-making Required to Produce a Large Ring.

Fig. 9.—Shows the Mould with Cores being Placed in Position.

Fig. 10.—Shows Finished Casting.

trouble by having allowed either too much or too little. Another trouble due to contraction is distortion. A thin plate may be moulded perfectly flat and true, but when the casting is taken from the mould it will be found to be warped. This is due to the fact that cooling takes place first at the corners, then along the edges, and lastly in the centre. This is specially noticeable when a boss is cast in the centre of the plate. The chance of getting a straight casting is very remote. In many cases this can be counteracted by making allowance for this camber in the pattern, but here again the pattern-maker is working in the dark, for it is difficult to tell how much the casting will go and in which direction it will warp and often several castings have to be made before the necessary allowance can be determined.

After carefully studying the drawing the pattern-maker proceeds to lay out the job full size to the contraction rule marking on all machining allowances and the exact position of cores, if any. In large work sections are laid down to enable him to visualise the job and map out the methods of building. In planning the building of a pattern, consideration has to be given as to the quantity of castings likely to be required and the strength required to resist the necessary ramming and withdrawal from the mould. The size of the job will, of course, decide a great deal. It is really surprising the amount of pressure put on a pattern when rammed up and the pull required to remove it from the mould. The pattern has, therefore, to be constructed to withstand the pull and not come to pieces when being withdrawn. Taking pattern-making in its simplest form, it is the making of a model which will be practically a duplicate of the casting required. If it is desired to produce a casting off a block, say 12 in. square by 2 in. thick, the pattern is simply a block of wood to these sizes. If a casting of a simple lever is required, the lever is reproduced in wood, sometimes making the pattern in halves to facilitate making the joint in moulding. But the time comes when more vital decisions have to be made. A casting of hollow box form with overhanging flanges or pockets may be required, and in this case the pattern, if made exactly as drawing, could not be withdrawn from the mould. Cores or drawbacks may have to be resorted to, or there may be loose pieces on the pattern which can be drawn into the mould after the bulk of the pattern has been withdrawn. In numerous cases all three methods have to be used on the same pattern. The decision as to whether a core or a drawback should be used is most important, as the cost of moulding may be considerably increased, and it is in a case of this sort that the foundry could with advantage be consulted and give their decision.

In some cases it is possible to produce a casting without going to the expense of a pattern. This is done by a method which, though sometimes entailing greater cost in the foundry, may save considerable cost in the pattern shop.

Moulding a Pipe.

As an illustration, a large straight pipe may be taken. All that is required from the pattern shop is a plain straightedge or strickle and two flanges. The core-maker strikes the core up on a barrel of suitable size, using the straightedge, testing the diameter with callipers and finishing off to a nice smooth surface. After this has been dried in the stove it is again placed on the horses, and he adds another coat of loam equal in thickness to the thickness of the metal of the pipe, and the pattern-maker is then called in to set the flanges on the body to the exact length of the pipe. This is called a loam block or loam pattern. The moulder then uses this in the usual way, bedding the block into the floor up to the centre line; making his joint along the centre line and covering the top half with a moulding box. After he has moulded both halves, the top box is lifted off and the loam block withdrawn. The mould is finished, the flanges and the thickness of loam over the core are stripped off, and core used in the mould. Steam-engine cylinders and numerous cylindrical castings can be made in this way by the addition of parts which can be set up on the loam block. Thus there is what is called the necessary tackle for making loam moulds.

Condenser Water Box.

Cylinders and such large castings as turbo-generators, yokes, endbells, condensers, waterboxes and covers, and the like can be produced in loam without making full patterns. It would be quite a big job, and require a good deal of illustration to show the making of a generator stator casting, but a short general description of a mould for a surface condenser waterbox will show the principles. Figs. 1, 2, 3 illustrate the boards or strickles and general details of the mould set up in loam. The spindle, which may be any

diameter to give a rigid centre, is fixed in a suitable footstep in which it may revolve. On the spindle there is an arm which carries the strickles. This arm is made to slide up or down to any required height. Sometimes the spindle is a fixture in the footstep, and the arm revolves on the spindle between two collars. When the job is a deep one, two arms are necessary to hold the boards or strickles. A cast-iron plate of convenient size and thickness for the work in hand is set up level over the footstep, and the spindle, with the arm attached, is placed in position through a hole in the centre of the plate. The board which forms the seating for the core is bolted to the arm and set at a suitable distance from the plate. The plate is wetted with clay-wash, and a thin facing of loam is levelled on top of plate. The moulder then proceeds to build up on this to form the seating for the core. The bricks are laid with soft loam with open joints to allow air and gases to escape freely when the mould is being poured. The brickwork is faced with a coating of loam which is swept up in a rough state, and is then given another coating of fine slurry and swept up smooth and true with the seating board attached to this arm revolving round the spindle.

When building up the brickwork the moulder has to make provision for the branches or any facings which may come in the way. When the seating is complete the strickle is changed for the core strickle. A cast-iron ring is placed in the bottom of the seating, and on this the moulder

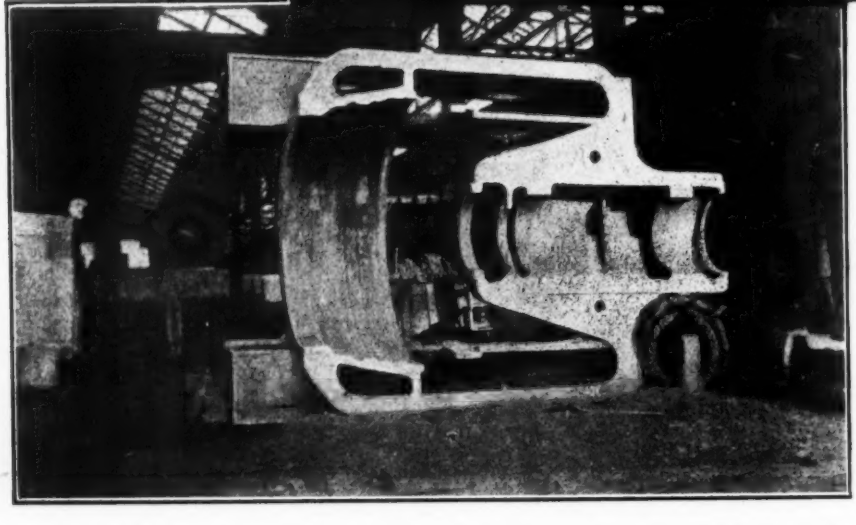


Fig. 11.—Shows Pattern of Turbine Cylinder being Rammed Up.

Fig. 12.—Shows View of Mould after Finishing and Ready for Coring Up.

Fig. 13.—Shows Casting. Note Intricate Coring.

bricks up the centre core, facing the outside of the brickwork with loam and striking up smoothly. The bottom core ring is provided with staples for lifting, and when the core is finished to the required height as determined by the board it is lifted out of its seating and placed on one side out of the way. The outside of the mould is then proceeded with. The core strickle is taken off the arm and replaced by the strickle for the outer diameter. The branches for which full patterns have to be provided are now accurately set up in position, usually by the pattern-maker, all the centre lines and measurements being taken from the spindle. The branches being in position, the moulder then builds up the outer wall of the mould, making provision for runners and the joint over the top half of the branches. The joint is necessary, as the branch pattern has to be withdrawn from the mould and provision has to be made for setting the branch core in position. The outer wall is built up and faced on the inside with loam and struck up true with the strickle which forms the outside of the casting. The top part of the mould is struck up on a plate separate from the mould using another spindle, and the strickle provided for this purpose. The building and strickling complete, the moulder now carefully removes the branches, all facings, flanges and loose pattern parts from the mould, and proceeds to make up any broken edges and finish off the mould. All surfaces which come in contact with the metal are given a coating of liquid blacking, which is carefully smoothed off to give the surface of the casting a good finish. The whole mould is then placed in a stove, and all moisture thoroughly dried out of it.

When dry the mould is placed in a pit for assembling. The centre core and branch cores are placed in position, all core vents being carefully cleared and the mould closed. The outside is then rammed all round with floors, and to strengthen the walls to withstand the pressure inside the mould when it is poured. The runner boxes are placed in position and made up, and the mould is ready for casting. This is only a rough description of making the mould, but it gives some idea of how this class of pattern is used. Small sizes of waterboxes are usually moulded from full patterns, the flanges on one side being left loose and the cores made in boxes. This is the most economical method of moulding, but in larger sizes the extra cost of the pattern would be prohibitive. In the same way fly-wheels, large pulleys and the like can be made either from full patterns or from a mould built up in cores, or from a mould struck up in loam with cores to form the arms.

Turbine Cylinder.

Fig. 4 illustrates the inlet end of the top half of a turbine cylinder. The mould for this casting was built up entirely in loam, and only a small amount of pattern-making was required for the comparatively large job. It is approximately 5 ft. diameter, and stands about 3 ft. high. Fig. 5 shows all the pattern-making required to produce this mould. This is a very good illustration of how simplicity of design helps to lower the cost of production, for though the cost of moulding was rather more than it would have been if full patterns and coreboxes had been provided, the cost of the pattern and boxes would have been considerable, and the saving in the foundry so small comparatively that we would not be justified in incurring the extra cost.

Skeleton Patterns.

When only one casting is required, and in cases where a casting may be only seldom called for, it is possible under certain conditions to rig up a cheap or temporary pattern. Flat plates can be made from a simple frame made to the outside sizes and thickness, the sand in the centre being strickled out. A plain ring can be made from a segment attached to an arm and rammed up a number of times to form the circle. Pipes of all sizes are frequently made from skeleton patterns. In many cases large skeleton patterns are made when the designs lend themselves to this class of work, and the number of castings required does not warrant the expense of full patterns.

Fig. 6 shows case of a typical skeleton pattern for the bottom half of the inlet end of a turbine cylinder. Owing to the irregular shape, it was hardly practicable to sweep up this mould, but the design lent itself to the making of a skeleton pattern; and Fig. 7 shows the casting ready for shipping. It is of interest to realise that the pattern-making in this case cost considerably less than full patterns, but the moulding cost was approximately one-third more than if full pattern had been used. This shows a good saving on the first casting, but, should this casting be repeatedly called for the extra cost of moulding and the cost of fixing up, the pattern every time required will counteract any saving made. Sometimes only the outside of the mould can be struck up, and the inside is formed by cores made in core-boxes, and in some cases the centre core is struck up away from the mould. This depends upon the designs and various conditions. Loose wood patterns for moulding in green sand are made in various ways, according to their size and contour. Patterns for bedplates and castings of hollow box section are made in sections, each section being built up of frames half-lapped together and sheeted over with boards.

In patterns of large size it is out of the question to make them solid. It is obvious that they would be too heavy to handle, and by framing and boxing considerable saving in timber is effected, and the pattern will retain its shape better.

Allowances for Taper.

When making a pattern, it is necessary to make allowances for taper or draft to enable the pattern to be readily withdrawn from the sand. It will be readily understood that when the sand is firmly packed around and into all the corners of the pattern, it is liable to take much pull before it can be removed, and, if the pattern is perfectly parallel, it is impossible to withdraw it without disturbing the shape of the mould. In the same way, if sand is rammed round a pattern, there must be clearance to withdraw the pattern, and the only way to provide the necessary clearance is either by excessive rapping, which knocks the mould out of shape, or by allowing sufficient taper, which, after a slight rapping of the pattern will enable it to be readily removed from the sand. The question of taper is generally left to the pattern-maker to decide, and he is generally accused by the moulder of leaving insufficient. To quote from a recent article: "The attainments of the pattern-maker in the way of draughting and working wood into various forms count as nothing to the moulder if he constructs patterns that will not draw. The moulder's skill is proved by having a 'good cast'; the pattern-maker's (if he only knows it) by having a good draw. To have the corners, edges, or portions of a mould started or broken through ill-drawing patterns is not only aggravating, but is often the cause of defective castings. Though this matter is one which has been left to the pattern-maker to deal with, it is one which might well be considered by the draughtsman before the drawing comes to the pattern shop.

The pattern-maker's difficulty is in determining which way to allow the draft, that is, whether to make his pattern larger at one end or smaller at the other than drawing sizes. Sometimes a middle course is taken, and it is made a little larger at one end and a little smaller at the other. Even then trouble may be encountered, especially when the castings have to be machined in jigs, as slight variations in sizes at the location point throw the centres of holes out of position. The amount of taper to be allowed on a pattern will vary according to conditions. It is often necessary that certain parts have to be as square as possible, but wherever practical taper should be allowed. It will be obvious that, if a pattern is tapered so that it will leave the sand freely, the life of the pattern will be prolonged, as it will not require to be rapped. The mould will be truer to shape for the same reason, and will not need to be mended up, as is sure to be the case when a bad draw results, and we will agree that it must be particularly aggravating to any conscientious moulder to have his mould pulled to pieces and have to patch it up again.

XUM

When the outline of a pattern is such that the mould has to be jointed through the centre line, as in the case of a cylinder, it should be made in halves. It is not always necessary to do this, but in most cases it is expedient that it should be so. It will facilitate the making of the mould joint, and more particularly it will save any disturbance of the sand when the top and bottom halves of the mould are separated. Each half of the pattern can be more readily withdrawn from the mould, it is often necessary to leave deep bosses and brackets loose, and when the pattern is withdrawn, the boss or bracket is left in the sand, and each piece is afterwards withdrawn separately.

Plate Moulding.

It is true plate moulding has not been developed in this country to the same extent as has been the case in America. Quantity production has not been appreciated in the same degree, and owing to the lack of standardisation in the engineering industry, the need for it has not been so great. In recent years, however, manufacturers have become alive to the fact that only by such methods will they be able to hold their own in the markets, and are adapting their plants to cope with modern requirements. Under these conditions arrangements must be made with the draughtsman to simplify his design. The foundryman must endeavour to understand what the designer wants, and why the pattern-maker desires to do certain things. The designer must understand that the moulder has his difficulties to overcome, and is in a position to make suggestions which may enable a casting to be more readily produced, and should be prepared to consider any suggestions made. Designs should be carefully considered before put into work to ensure that they will be quite standard, as changes in this class of work are often very expensive to make, and patched up patterns do not tend towards rapid production, often being responsible for bad draws in the mould.

It does not follow that because a pattern is on a plate that it must be used on a machine. There are some jobs that can be more economically worked from a plate pattern rammed by hand. No matter whether one is using a machine or not, it is undoubtedly true that there are advantages in using pattern plates for repetition work over using loose patterns. With pattern plates the joint is already made and an accurate parting is assured. Plate moulding means that instead of the pattern being worked loose in the sand it is fixed on to a plate which may be either wood or metal, and the plate follows the joint line of the mould. In the foundry with which the writer is connected small patterns are fixed on metal-machined plates which are generally used for standard product in large quantities, and on machine boards for what may be termed semi-standard for smaller quantities, and the larger patterns are put on wood boards called follow boards to be worked on the foundry floor. The term "follow board" signifies that one board follows the other or matches up to the other.

Whether a machine is used or not there is unquestionably great advantage in using plate patterns for repetition work. Moulding boxes should be standardised as far as possible, and so arranged that no superfluous sand has to be rammed. The patterns can then be arranged on certain standard plates or boards. With small loose patterns it is possible to group them together and make what is called an oddside. This may be made from sand, plaster of Paris or similar material, and forms the joint of one half of the mould. The first box is rammed up on this with the patterns in position and rolled over, the oddside is then removed, leaving the patterns in the half mould. The other box is then placed in position and rammed up in the usual way. But though this does effect a saving in time, the patterns will still have to be handled, whereas with the pattern plates the patterns are fixed to the plate and all withdrawn together. It will be obvious how efficient the draw will be, seeing that the plates and boxes are all drilled to the same centres, and the pins in plates and boxes form steady guides in drawing the patterns.

Mounting Patterns on Plates.

In plate moulding, when a pattern is in two halves, each half is fastened on a separate plate, each part is rammed up separately, and the moulding boxes are not brought together until the mould is ready for closing. With the plate the joint of the mould is made as the moulder rams his mould, and is quite accurate and requires no finishing.

Having decided on pattern plates and knowing what size boxes to use, the patterns must be arranged to fit as large a number as possible on the plates. This will depend on the size and peculiarities of the pattern. Very often it is only possible to get one pattern on, and sometimes as many as eighteen to twenty small patterns can be fixed on one plate. It will be obvious that when so many are on one plate the greatest accuracy has to be exercised, as each must be a duplicate of the other. It must not be imagined that only small patterns can be adapted.

Patterns of quite large dimensions are dealt with in the same way, the only consideration being that there should be sufficient quantities required to warrant the initial expense, which in the case of plate patterns is somewhat high. When two halves of a pattern are placed on separate plates, when the mould is made and the two halves are brought together, the halves must match up exactly, otherwise there will be overlapping at the joint, or in the case of a casting of a disc section there will be thick and thin metal. Obviously considerable care must be exercised in registering the respective halves, to ensure true castings.

To obtain a true register two halves of a pattern are dowelled together. The pattern is then secured to the plate and drilled through the dowel holes. The two plates are then placed face to face on the pins and the other plate is drilled, the first plate forming a jig for the second. The patterns can then be dowelled in position and secured by screws. Sometimes a job can be registered through the plate. In very many cases the patterns have to be set by measurement, all measurements being taken from the pin centres. By accurately placing a number of patterns having a flat surface along one side of a plate, a double number of castings can be obtained. Both top and bottom halves of mould are made from the one plate, and in placing the one half on to the other half the impression is on opposite sides. The runner is placed along the centre of the plate and the double set is produced, one on the bottom-half and the other on the top-half. If double the number of patterns were placed on one plate the moulder would have still to ram a top half, so the cost of half the pattern is saved.

Loose parts in this class of work should be avoided wherever possible, owing to the danger of these getting out of position in the mould, with the resultant loss of the casting, and the risk of their being lost in handling and storing. Unfortunately, loose pieces cannot always be avoided, and wherever they are used every care should be taken to ensure that every piece will fit into its proper place.

The degree of accuracy which is being called for in a rough casting to-day is really astonishing. This is due to the fact that repetition in the foundry is also repetition in the machine shop, with the use of jigs to simplify the operations of machining. These jigs are usually made to a drawing on which no allowance has been made for any slight irregularity in the casting. The jig-maker, not realising that the moulder is working in sand, which is subject to distortion from any slight cause, such as the tapping of the plate or the withdrawal from the mould, or even the pressure of the metal when poured into the mould. The pattern-maker can sometimes make certain allowances, but he cannot always take care of this trouble, and in making jigs when a casting is not available a little discussion would many a time be beneficial in fixing certain location points which could be almost guaranteed.

Discussion on Mr. Mortimer's Paper on "Aluminium Foundry Practice."*

The Chairman (Mr. J. Masters) said they would all agree they had listened to a very instructive lecture, and he would be glad to know why Mr. Mortimer used so strong a binder as 25 parts of dry sea sand to 1 part of a mixture of molasses and linseed. He had seen cores made in oil sand with very much weaker structure, and the results were quite good. They were indebted to Mr. Mortimer for bringing with him Mr. Baker, who was understood to be an expert in the Selas Turner furnace, to which reference had been made, and if Mr. Baker would tell them something about his experience, no doubt it would be useful to some of the members.

Mr. Baker asked Mr. Mortimer whether it was his practice to skim the metal in the Selas tilting furnace. He believed in most cases there was not frequent skimming of the metal, because of the quantity of dross. But in many foundries where this furnace was employed they skimmed about every five minutes, and the castings turned out seemed to be very satisfactory. The practice of the patentees in this respect had no deteriorating effect on the efficiency of the furnace. Mr. Mortimer had stated that the linings in a reverberatory furnace lasted about a year. In the Selas type the lining had a much longer life. He knew one where the lining lasted six years without renewal, though the furnace was in continual use.

Under proper conditions gas and air were mixed in correct proportions, and all the pressures were regulated, thus the furnace was very suitable for die castings production. Mr. Mortimer had not mentioned anything about the costs. A large number of the furnaces were in use, but when the users were asked for certain particulars three replies only were received. These replies showed that the loss of metal in melting was less than 1 per cent., a low figure considering that the metal was in actual contact with the flame.

Mr. J. S. G. Primrose said Mr. Mortimer had opened up an almost completely new aspect of moulding practice, because they were dealing here with casting temperatures in the vicinity of 700 deg. C., which was much below what one usually heard of in the iron or brass foundry. He recalled a case where a practical moulder said he did not even bother to light the gases which came out of the cores when casting aluminium. He was immediately tackled on the question how the moulders were affected by the carbon monoxide given off, and was apparently annoyed that his right to "gas" the unfortunate workmen was disputed. Mr. Mortimer had not referred to that point. It would be interesting to know whether he lighted his mould gases, and prevented the men from suffering in that way.

He had been very much interested in Mr. Mortimer's reference to melting in iron pots, especially as it was pointed out that iron could produce a very deleterious substance in aluminium castings, but that there was a method of overcoming that difficulty by using a coating with graphite wash followed by a thin coat of whiting and waterglass. That was quite a good idea, but he wondered whether Mr. Mortimer had tried another method, in which the aluminium itself was made to protect the iron pot. That was the process known as calorising, in which aluminium oxide was formed.

Mr. Mortimer had said it was very difficult to burn aluminium, but he had also said that it took up oxygen. Now, if it took up oxygen, presumably aluminium oxide was formed, and when a thing was oxidised, theoretically it was burned. What did Mr. Mortimer mean by the term burned? Because he told them that by re-melting and pouring at a high temperature that gas difficulty was overcome. No doubt he removed the gases in solution; but how did he get rid of the oxygen which was in combination?

Another point on which further information would be welcome was crystallisation shrinkage. From various sources they had learned about liquid shrinkage, which occurred while the metal was cooling down to freezing point, and solid shrinkage—or contraction, as it was usually called—which occurred after the metal had solidified. Now Mr. Mortimer had been telling them about what happened just as it was crystallising, and he gave a figure of 7 per cent. as the contraction or diminution in volume attributable to this cause. It must surely take place within a very short range.

The pencil runner arrangement which had been shown was going back to Ronceray's idea. It seemed to bear out fully the fundamental principle of slow pouring and self-feeding, which was much better than slopping in the metal. Many foundrymen favoured the idea of pouring the metal from a height to get better pressure, but this was a fallacy, and he was glad that Mr. Mortimer had emphasised that.

Mr. J. Drummond Paton said the lecturer had been very generous in giving information; and in return he would advise him to consider the use which could be made of high silicon iron in pots and dies. Perhaps the Chairman would recall a Paper by the speaker in which he described various dies made of high silicon "steely" iron; chippings from the working faces of these dies, when cleaned up for repair, showed on analysis ferro-silicate of alumina. The references to the use of silicate of soda and whiting seemed to indicate that the lecturer was moving in that direction.

In the Selas furnace installation were the waste gases utilised? He himself had been trying to get a combination furnace which melted primarily in iron as a preliminary to finishing in a crucible, and in which the gases were utilised for core drying, enamelling and other purposes.

Was the crystallisation shrinkage specially referred to accompanied by any exothermic or endothermic reaction, and in the region of a recalescent point?

THE AUTHOR'S REPLY.

Mr. Mortimer said that where dealing with cores so delicate and intricate as those he had in mind a very strong bond had to be used. He had intended to bring an example some 2 ft. 6 in. long and varying from $\frac{1}{2}$ to $\frac{1}{8}$ in. in thickness: his remarks should have been co-related with that sample. He quite agreed that on heavier work a lighter bond was satisfactory and normal practice.

Mr. Baker had asked whether they skimmed in the case of the open-flame tilting furnace. They skimmed very thoroughly just before pouring, taking care to disturb the melt as little as possible. If one skimmed every five minutes it was true that the metal was not hurt: one only skimmed the oxide and dross off the surface. The dross losses would, however, be high. He had heard that one objection to this class of furnace was the quantity of dross produced, and if skimming were carried out so frequently he began to see how that rumour had started. He was very glad to learn that a single lining might last six years.

A die-casting should essentially be strong and sound. Where die castings turned out brittle and porous, it could generally be traced to ignorance of the characteristics of these alloys. Metal was thrown into dies to get sharp definition. Some of it was spilt on the floor and returned to the pots with dirt; possibly a waster or many wasters were produced, and these went back also, and the whole possibly overheated and maintained so for long periods. Die castings produced under those conditions were brittle. It was through such conditions that at one time die-castings had a reputation for unreliability.

Generally speaking, the costs in an aluminium foundry were low in comparison with other metals. The low weight and melting point made for economy; the casting process was on the whole easier, and machining was extremely rapid and light on tools.

* This paper has appeared in our last three issues.

Protection of Melting Pots.

He was much interested in Mr. Primrose's remarks on calorising, and proposed to try it out in the case of 2L5. Spraying with aluminium bronze, which formed a neutral oxide protection, had been found satisfactory. From the practical point of view, however, the ordinary whiting and waterglass wash worked well, and was better understood by furnace hands. The life of an iron pot was generally determined by the action of furnace gases on its exterior, with consequent scaling. That aspect was assisted by choice of pot material and by spraying the outside with aluminium by the Schoop pistol.

He had used the term "burning" aluminium in its colloquial sense only. What he meant was that aluminium could be raised to very high temperatures, and although oxide formed heavily at the surface, the metal beneath was not materially affected so far as its physical properties were concerned, except for the absorption of gases which could largely be removed again.

Crystallisation Shrinkage.

By crystallisation shrinkage he meant that shrinkage which took place whilst the metal changed from the liquid to the solid state. The liquid shrinkage of these alloys is roughly about 1 per cent. per 100 deg. C. In changing from liquid to solid, an abrupt shrinkage of some 7 per cent. took place. From the moment of solidification until the casting was cold there took place the ordinary contraction allowed for in the pattern-maker's scale: for these alloys about one in eighty.

Pouring from the height was a most detrimental practice. It was said that by dropping the metal into the mould in that manner extra pressure was obtained, but the stream of metal carried down air with it, and led to blow-holes, porosity and excessive dross.

Reclaiming Aluminium Scrap.

A question was asked as to the best method of reclaiming aluminium scrap.

Mr. Mortimer replied that aluminium scrap could be divided into several classes. Large scrap, such as cracked or mis-run castings, gates, risers, spillings, etc., could be returned to a pot for use in castings of secondary importance.

Skimmings from pots and crucibles carried much entrained oxide, but the addition of from 0.5 to 1 per cent. of zinc chloride assisted the oxide to rise to the surface as a fine dusty powder, duly skimmed off. In large plants separate furnaces were detailed for this work, and skimmings dealt with continuously as they were collected.

The most difficult problem was met with in the large quantity of sawings and other swarf. Each particle was necessarily enveloped in a skin of oxide, and the weight of metal therein was insufficient to break down that skin and allow particles to flow together. To attempt direct melting of such fines was doomed to failure from the economical standpoint: the temperature required to melt the mass merely toughened the skin of oxide on each particle: continued heating at higher temperatures resulted in the whole charge being converted to oxide, the effect becoming very rapid as soon as flashes started here and there in the charge. Rather than attempt this procedure it was actually cheaper to dump the fines in a canal. A molten heel to start with helped matters, but the weight recovered, minus that of the original heel, was generally disappointing. If, however, that heel were only plastic instead of liquid, and the fines added a little at a time and rabbled into the mass, the yield was in the neighbourhood of 90 per cent. of the metallic content. What happened was that the skin was then mechanically broken, and the particles welded into a mass, at a temperature at which welding best took place and rapid oxidation did not. When the pot was too full for convenient handling the temperature was allowed to rise until the melt was thoroughly fluid, about 0.5 to 1 per cent. of zinc chloride stirred in, and the pot skimmed and ladled off into ingot moulds.

Mr. Mortimer, in reply to Mr. Paton, said that the iron used in pots was as far as possible free from phosphorus. He had not heard of the value of high silicon content in this connection, and would be interested to try whether a high content of silicon in iron pots gave the good results observed by Mr. Paton in connection with dies. In the Selas furnace waste heat was not used as suggested by Mr. Paton: there seemed to be little heat wasted in this type. The waste heat from some of the banks of iron pots, however, was led through core ovens, and supplemented if necessary by the usual gas burners.

He did not think that there was any marked exothermic action during the solidification range of the alloys dealt with: in the case of the silicon group there was a certain expansion just before solidification.

Mr. S. G. Smith, in proposing a vote of thanks, said many of the points made by the lecturer applied to other metals as well as to aluminium, and those members who were not directly concerned with the production of aluminium castings were indebted to Mr. Mortimer for the way in which he had put them forward and answered questions. The problem of pouring was rather too extensive to go into at the moment. Mr. Mortimer had given cases where the pouring was slow, and other cases where it was fast, because the conditions were different. That applied equally to the iron foundry. It had been stated that the "Y" alloy which appeared in the first slide acquired very great strength under heat treatment. It would be interesting to hear what that heat treatment was.

Mr. T. W. Markland, in seconding the vote of thanks, said he had been going into the problems connected with aluminium, and what he had read agreed with what Mr. Mortimer had stated. Not very much was known about it at present, but he felt they were on the high road to understanding it. Perhaps Mr. Mortimer would explain what was the idea of having the horned runner. Presumably it was to avoid splashing. What metal would he recommend for making aluminium patterns?

The vote of thanks was carried by acclamation.

Heat Treatment of "Y" Alloys.

Mr. Mortimer, in reply to Mr. Smith, said the heat-treatment for "Y" alloy consisted in maintaining at an even temperature of 510 deg. C. for five or six hours, generally in a bath consisting of equal parts of sodium and potassium nitrate, to guard against fluctuations in temperature. He would not much exceed 510 deg. in heavy castings: the temperature might fall to 500 deg., but preferably nothing lower. The castings were then quenched in boiling water, and to hasten "ageing" they were often kept in boiling water for a couple of hours. They were then aged for at least five days.

The horn gate was used for three reasons: firstly, it was a convenient shape to withdraw from the sand when moulding; secondly, it led the metal into the mould without splashing; thirdly, it acted automatically as a skim gate for the incoming metal, and the metal entered the mould very clean. The best metal for aluminium patterns was patented. A very useful one was aluminium with from 6 to 8 per cent. of metallic silicon, which gave very clean castings without trouble and with a low shrinkage.

Catalogues Received.

Cast Iron Pipes.—The May stock list issued by the Staveley Coal & Iron Company, Limited, of Chesterfield, is now available.

Permanent Mould Machines.—The Holley Carburetter Company, of Detroit, U.S.A., have sent us an 8-page catalogue describing and illustrating the machines they have designed and perfected for the manufacture of iron castings in permanent moulds.

Plastic Refractory.—Mr. Sydney Evans, of 9, Bush Lane, Cannon Street, London, E.C.4, has sent us an eight-page pamphlet describing the method of applying a plastic refractory called "Dumonite," for use with cupolas, converters, ladles and blast furnaces

The Institute of British Foundrymen.

Annual Convention at London, June 15, 16, 17, 18 and 19, 1926.

The following programme has been arranged in connection with the annual convention, to be held in London from June 15 to 19, 1926.

The railway companies (except the Metropolitan and London Electric Railway Companies) have agreed to issue tickets at the ordinary single fare and one-third for the double journey, fractions of 3d. reckoned as 3d. Minimum adult fare, 1s., to passengers travelling to attend the Convention, upon surrender, at the time of booking, of vouchers, obtainable from the Convention Secretary. The tickets will be available from June 12 to 21.

Numbers are limited at all the works who have invited delegates. The available tickets, therefore, will be issued strictly according to priority of receipt of application, and will not be transferable.

Programme.

TUESDAY, JUNE 15.—7.30 p.m. A cordial invitation is extended by the London Convention Committee to all members, delegates, and ladies to a reception at the Spring Gardens Gallery (Old County Hall), Spring Gardens, Trafalgar Square. Music and refreshments.

WEDNESDAY, JUNE 16.—9.30 a.m. Conference commences at the Royal Agricultural Hall, Islington, N. Welcome by the Rt. Hon. Arthur Henderson, P.C., M.P.

1.15 p.m. The officers of the Institute and the Reception Committee are invited to lunch at the Royal Agricultural Hall, by Messrs. F. W. Bridges & Sons (organisers of the Foundry Trade Exhibition).

1.30 p.m. The Convention Committee invite all ladies to join a motor coach trip to the Royal Botanic Gardens, Kew. Tea will be provided in the Gardens.

2 p.m. Official visit of all members and delegates to the Foundry and Allied Trades Exhibition at the Royal Agricultural Hall.

4 p.m. All members and delegates are invited to tea at the Royal Agricultural Hall, by the courtesy of the organisers (Messrs. F. W. Bridges & Sons, Ltd.).

7.30 p.m. Banquet at the Hotel Cecil, Strand, W.C., for members, delegates, and ladies. (Morning or evening dress.) Tickets, 12s. 6d. each.

THURSDAY, JUNE 17.—9.30 a.m. Conference resumes at the Royal Agricultural Hall, Islington, N.

2 p.m. For ladies and any member not participating in works visits, a motor coach trip has been arranged to Hampton Court, etc. Tickets, including tea, 9s. 6d. each.

1.15 p.m. Motor coaches will leave the Embankment entrance of Charing Cross Station conveying limited parties of members who are invited to visit one or other of the following works:—Messrs. Fraser & Chalmers, Limited (General Electric Company), Erith, Kent; Messrs. J. & E. Hall, Limited, Dartford, Kent; Messrs. Harland & Wolff, Limited, North Woolwich; Messrs. Gillett & Johnson, Limited, bell founders, Croydon; The National Physical Laboratory, Teddington, Middlesex. A party is also invited to visit the works of Messrs. Dewrance & Company, Great Dover Street, S.E., but, as the works are within easy access, the visiting party will travel independently, and meet at the works at 2.15 p.m. Refreshments will be provided by the courtesy of the firms whose works are visited.

8 p.m. Banquet at the Royal Agricultural Hall to overseas delegates and visitors, Institute and Conference officials, by the courtesy of Messrs. F. W. Bridges & Sons, Limited. Invitation by special ticket only.

FRIDAY, JUNE 18.—9 a.m. A party of about 100 members and ladies are invited to visit the Letchworth Garden City. Depart by special motor coaches from the Embankment entrance, Charing Cross Station. Arriving at Letchworth, the party is invited to tour the Garden City, by the invitation of the First Garden City, Limited.

1 p.m. Lunch, provided by the courtesy of the Directors of the First Garden City, Limited.

2 p.m. Members of this Letchworth party are invited to visit one or other of the following works:—Messrs. Kryn & Lahy's Metal Works, Messrs. Foster Instrument Company, Limited; Messrs. The British Tabulating Machine Company, Limited; Messrs. Furmston & Lawlors' Pattern Shops. With the exception of Messrs. Kryn & Lahy's Metal Works, the invitations are limited in number, but the small parties who wish to visit the other works are at liberty afterwards to join the main party at Messrs. Kryn & Lahy's Works, which are within easy access. Tea will be provided by the inviting firms.

2 p.m. Ladies of this Letchworth party are cordially invited to visit one or other of the following works at Letchworth:—The Spirella Corset Company's Works; The Marmet Baby Carriage Works. For the benefit of members who wish to avail themselves of a free morning in London, arrangements have been made for afternoon visits only to the following works:—

11.30 a.m. Braintree: At the invitation of Messrs. Lake & Elliott, Limited. Depart by special motor coaches from the Embankment entrance, Charing Cross Station.

12.15 p.m. Dunstable: At the invitation of Messrs. Bagshawe & Company, Limited. Depart by special motor coaches from the Embankment entrance, Charing Cross Station. Luton: At the invitation of the Davis Gas Stove Company, Limited, and the Skefo Ball Bearing Company, Limited. Depart by special motor coaches from the Embankment entrance, Charing Cross Station.

SATURDAY, JUNE 19.—Day excursion by special trains and steamers, up the River Thames to Windsor, Eton, etc.

9.24 a.m. Depart by special train from Bishops Road Station, Paddington.

10.13 a.m. Arrive Staines.

Leave Staines by special steamers, passing Egham, Magna Charta Island, Runnymead, Windsor Great Park, Eton College, etc.

Lunch at Windsor, and two hours ashore for sight-seeing.

3.30 p.m. Depart Windsor, up stream, passing Bray, Maidenhead, Boulter's Lock, Cliveden Woods, Cookham, Bourne End, etc.

Tea on board.

7.5 p.m. Depart Bourne End by special train.

7.47 p.m. Arrive Paddington.

Tickets for the trip, including lunch and tea, 15s. each.

A minimum number of 300 has been guaranteed for this charming up-river excursion. It is, therefore, hoped all members and ladies will avail themselves of it—the social finale of the Convention.

Papers at Conference.

(1) *American Exchange Paper*, "Quantity Production with Quality of Product," by Mr. Arnold Lenz, of the Saginaw Products Company, Limited, Saginaw, Mich., U.S.A.

(2) *French Exchange Paper*. "Foundry Sands," by Monsieur Lemoine.

(3) *Belgium Exchange Paper*. "A Comparison of the Results obtained when Improving the Tensile Qualities of Cast Iron," by Monsieur L. Piedboeuf.

(4) "Chemical Reactions in the Cupola, with Special Reference to Fuel Consumption," by Prof. F. C. Thompson, University of Manchester.

(5) "Influence of Rate of Cooling on Cast Iron," by J. E. Hurst (Member).

(6) "Non-Ferrous Metallography," by J. S. Glen Primrose (Assoc. Member), Manchester.

(7) "Some Notes on the Production of Cylinder Pig-Iron to Fracture and Analysis," by E. J. Yates, B.Sc. (Met.).

(8) "Cast Iron for Electrical Machinery," by J. H. Partridge, B.Sc. (Hons.), Birmingham.

SOUVENIR BOOKLET.—A Souvenir Booklet, giving programme in detail, will be supplied to each member and lady attending the Convention.

CLUB.—The Engineers' Club, Coventry Street, W.1, have kindly promised to extend the privilege of temporary honorary membership to Members of the Institute for the period of the Convention, and those wishing to avail themselves of this courtesy are requested to make application on the reply form.

XUM

A French Conception of Foundry Costing.*

By René Dureuil, of the Forge and Foundry Works of the Société des Moteurs Gnome and Rhone, Gennevilliers.

The purpose of industrial accountancy in a works, said M. Dureuil, was to ascertain the working results. Results were, however, not merely a question of ascertaining a final and sole figure representing the profit or loss realised during the business year. That could be done by financial accountancy alone. Industrial accountancy was a question of *all* the working results. The result in profit or loss was obviously the final point, but there were a great number of others of which this final point was the resultant.

The two principal components were the selling price, on the one hand, and the coal manufacturing cost price on the other. The selling price was known. It was fixed before entering upon any manufacturing expenditure or, at least, it ought to be. It was otherwise with the manufacturing cost price.

Another object of industrial accountancy was the construction of expenditure charts of every kind, and charts of the different movements which such accountancy is intended to regulate and distribute. There were still, however, other manufacturers who considered that their cost price was sufficiently determined by the ordinary bookkeeping accounts, namely, the supplies journal for purchases of every kind, the labour account, and the sales journal. All the materials were there. A few tables were compiled by accountants merely in name, and their cost price was determined. A rule-of-three sum gave the average price, which was employed as basis in the matter. This was a mistake. There was only one case in which the average cost price was serviceable, and that was in specialised works manufacturing only a single type of casting in large numbers. Immediately the products comprised castings differing in weight, form and appearance, the average cost price became almost useless as an index, for it could not show which castings it was most advantageous to produce, those which required their conditions of manufacture to be improved and those the production of which ought to be abandoned. This could be indicated only by the detailed cost price, and these considerations applied not only to foundries but to all industries.

The conception of cost price and its determination differed according to different authors. According to M. Nusbaumer, the manufacturing cost price was essentially an accountancy document and consequently a document accurate as a whole and accurate in its different terms. But in order to obtain from it all the information required it was necessary that these terms should correspond to precise things as to which knowledge was desirable. The essential components of cost price were materials, labour and general expenses. The average cost price thus determined could not furnish these precise components. It had nothing of an accountancy document about it. It was a figure which, while giving an accurate indication in itself—seeing that it started from exact data, viz., total expenditure and total manufactures—too frequently gave only a false idea and led to regrettable errors. Nusbaumer had said that cost price "ought to be determined and could only be determined by a special service entirely distinct from, and independent of, the manufacturing section." Such a service was industrial accountancy.

To attain its object it was insufficient for the accountancy service to centralise all the documents necessary for determining the cost price, and unnecessary for it to be certain that these documents, the sense of which it was to summarise, were really accurate. It should, however, exercise a check over all these documents, and consequently should have authority to control the manufacturing agents or any other agents called upon to furnish any contributory documents. The function of the chief industrial accountant was to interpret them and also, in particular, to control in a general way the entire plant. He was, in fact, and ought to be, the assistant manager.

The Organisation of Industrial Accountancy.

Nusbaumer, referring to industrial accountancy being independent of the manufacturing departments, has said that "as each section no longer itself estimated the cost of the products manufactured by it, it was not tempted to conceal or juggle with unproductive expenditure." In addition, however, each section ought not to be tempted to juggle with its excess *productive* expenditure when it observed of itself that this was too high. This occurred in two ways: first, from excessive materials owing to excessive waste disguised in one way or another, and, second, excessive labour owing either to disguised waste or to too high earnings of workmen.

The means of remedying this was the control of manufacture by accountancy, and the starting point and basis of this control was the drawing up of estimates by the industrial accountancy service on the data of manufacture—data which were binding in the event of an order. It followed as a corollary that the stores—no matter which—should not be under the orders of the manufacturing sections, but should be subject to the accountancy service.

The elements of the problem were available and could be planned out. On the one hand there was the manufacturing department with its office for the distribution and control of the work; on the other hand, there was the result to be obtained: the working balance-sheet and, immediately before, the manufacturing cost price. What means were to be adopted in order to obtain the one from the other? To follow a logical cycle they ought to begin with the obtaining of the order. This was not dependent on the works alone, but also on the commercial service. This operated, however, on the data of the works by means of estimates drawn up by the works themselves. (By "works" he meant that the works were subject to a head office, otherwise it was necessary to consider two agencies separately in the works—the commercial service and the financial accountancy service, which represented in a sense the office of a company.)

The accountancy section would be the estimate section. But as estimates led to orders and consequently to selling, the first section would be cognisant of everything relating to selling, and would be called the sales accountancy section.

The Sales Accountancy Section.

From the estimate point of view this section would proceed as follows: (1) On the receipt of the inquiry for price it would communicate it to the manufacturing section concerned, with a special printed form on which the latter would specify the factors for which it would be responsible, namely: (*a*) The probable weight of the casting or of the material to be worked; (*b*) the probable direct labour, with time in hours and minutes, and class of labour or wages scale per hour of the workmen qualified to execute the work in the event of an order. (2) Normal spoiled castings to be anticipated if the order was executed. (By spoiled castings is meant that a certain manufacturing risk must always be provided for. The manufacturing section could judge of this in relation to its estimate of the difficulty of executing the casting.)

The sales accountancy section now entered the value of the raw material and applied the general expenses corresponding to the various items and the margin of profit prescribed by the management. The normal selling price or estimate was thus established. The commercial service would deal with it to the best advantage, having regard to the state of the market and of competition and the amount of orders in hand. The manufacturing section must also indicate the normal period required for production, and in addition

* Address delivered before the Association Technique de Fonderie at the Ecole Nationale des Arts et Métiers.

the probable date of delivery, having regard to the duration of its previous engagements. It would likewise specify an option period in order to reserve a margin in view of further estimates should it consider these desirable, without prejudice to the period which the management might apply with regard to its supplies and the possibility it might have of covering itself for raw materials.

The somewhat general practice in foundry work of estimating per 100 kg. should be opposed. An estimate which, unlike the cost price, could not be a precise document, must be very carefully prepared to be sufficiently accurate. The only means of securing this was by studying the casting by itself. The estimate should be made to the casting, or, rather, for the casting, and should afterwards be converted into terms of 100 kg. if required. In support of this he would merely point to the importance of the form and volume of the casting in relation to the rammed sand, and particularly to the question of coring, which was even more important. Naturally, the direct labour should be shown in the estimate with as much detail as the cost price was capable of disclosing it, that was to say, in regard to its different industrial items: moulding, coring, cleaning, and sand blasting. The volume of the cores must not be forgotten. All these details were to be determined by the manufacturing section.

The order having been obtained, the sales accountancy section entered it in a register for that purpose. Since the accountancy department accounted for the firm's money, it would issue the order to begin the manufacture. No expenditure of any kind could be undertaken for manufacture until this order was issued. On this order would be entered the credit provided for labour (this would be precisely what was estimated for manufacture in drawing up the estimate). This credit must not be exceeded except by the rate estimated for possible risks. Similarly, if the state of the market or of the order book made it necessary to reduce the normal selling price to obtain the order, it would be for the manufacturing manager to reduce the labour as much as possible so as to keep within the limits permitted by the selling price. When the castings were delivered the sales accountancy section, which received a copy of the delivery note, would make out the corresponding invoice. It would register this delivery and invoice in its order books. It would enter the transaction in a general sales book corresponding to the period for which the accounts were made up, and make an analysis of it with orders corresponding to the same period. These were the main lines of the functions of their first section. The order having been obtained, the first step was the delivery of the raw material. The manufacturing section, being in possession of the order to manufacture, issued a requisition for materials through its works organisation office. This order came to the stores. The quantity and weight actually delivered having been entered on the order by the stores, the order then reached the accountancy section whose function it was to calculate its value.

The Materials Accountancy Section.

This section would be cognisant of everything relating to materials, viz., purchases, state and value of the stock, amount and value of consumption, etc. From the point of view of purchases two points had to be considered. In the stores there were a certain number of products which were in current consumption in the different manufacturing shops and their dependencies. It would be for the purchases accountancy section, in concert with the supply store placed under its control, to watch that the minimum stock provided for by the works organisation should always be maintained. On the other hand, there was another category of products specially relating to each manufacture: the special raw materials or tackle, regarding which the manufacturing section alone was capable of determining its requirements in relation to the estimates made or its engagements. Each workshop manager ought, therefore, to be provided with a register for entering his probable requirements sufficiently in advance, this register being at once transmitted to the materials accountancy section. In both cases the latter would issue the corresponding requests for prices, then, on receiving proposals and after the supplier was decided by the management, it issued the necessary supply order.

The workshop must indicate the minimum period in which it must use the goods ordered. In every case, on receipt of the goods the stores made out a corresponding "received" note. The accountancy section had this taken charge of by the competent service if necessary (the laboratory if analysis was required, otherwise the manufacturing section), and then entered it in its special register for purchase orders. On receipt of the invoice from the supplier it passed it if correct by the corresponding entries, ordering the financial accountancy section, whose duty it was to observe the general purchasing conditions, to effect payment. At the same time this accountancy section entered the invoice in its order book opposite the corresponding entry. It was its function to follow the normal course of supplies if there was no commercial service for supplies to deal with these questions, and also to make all necessary claims in due time in order that the terms of delivery should be observed. If there was a commercial service for supplies it operated in the same manner as regards accountancy, and did the same work as regards the claims in question.

The materials accountancy section also kept a purchases journal which corresponded to some extent with the supplies journal, entering in it at once the invoices received and passed by it for payment. It further kept permanent inventory books consisting of two headings—entries and withdrawals. The section recorded the entries as they took place in terms of quantity and value. This enabled it (1) to know at any time the value of the stocks and (2) to know the state of the stocks at any time, owing to the fact that it also registered the consumption orders passed to it by the stores. Thus it calculated the value of these consumption orders at the average price of the stocks in store. At the same time it supplied a statistical return of the periodical consumption by goods categories, and checked this consumption by the corresponding manufacturing orders. It also furnished a statistical return of the goods received, which enabled an effective comparison to be made with the payments and engagements of the finance department.

The raw materials having been delivered, they had now to be worked. At this point direct labour stepped in.

The Labour Accountancy Section.

As its name implied, this section would be concerned with all questions relating to labour. As in the case of materials so in that of labour, several things had to be considered; in the first place the question of salaries, and consequently that of wages, and the question of cost price, that was to say, the question of distribution. Job cards were issued by the works organisation office. The workman who received the work and executed it indicated on the job card the distribution of his time. The card went back to the works organisation office, which noted it, and then passed to the wages section, which periodically drew up the pay sheet. This done, the cards had to be analysed, and each charge had to be apportioned to the order which had necessitated the execution of the work. This was the second object of the labour accountancy section.

(To be continued.)

Manganese Deposits in South Africa.—At a recent meeting of the Geological Society of South Africa, Dr. A. L. Hall gave a description of the manganese deposits near Postmasburg, west of Kimberley. The existence of these ores was recognised in 1922 by Captain T. L. H. Shone, and their active development is now in progress. The deposit indicates a ferrograde ore; it contains from 42 to 58 per cent. of metallic manganese, no phosphorus, from 1.75 to 7.0 per cent. of silica, and from 3.25 to 10.9 per cent. of iron.

XUM

American Foundry Conditions.

Mr. J. T. Kay, who participated in the *Daily Mail* Trade Union Mission to the United States, reports * that American employers of labour are firmly convinced, after years of experience, that a wage which enables the worker to maintain a high standard of living and still leaves him with a margin for spending, or saving, is the best possible incentive to high production.

The spending power of the American worker, due to his high wages, is of great advantage to the home market, which consumes some 85 per cent. of the goods produced in the United States. High wages, which enable the workers to purchase articles outside the bare necessities of life, therefore make for high consumption and so prevent high production deteriorating into over production with consequent unemployment.

American Workers' Purchasing Power.

A striking example of the purchasing power of the American worker is afforded by the motor-car industry, which last year produced 4½ million cars. The workman who did not own or was not paying for a motor-car was the exception.

It is true that most of these cars are purchased on the instalment system, but I was assured that losses to the manufacturers—one-seventh of 1 per cent. on the year's total sales—were so small as to be almost of no account. The purchasing power of the American workers could be illustrated in many more ways, but the fact remains that they do buy things far beyond the dreams of the average British workman and that the wages they get enable them to do so.

It is said that American employers believe in putting 3½ horse power at the elbow of every workman, and I proved the correctness of this statement during the tour. Wherever it is possible to introduce any appliance that will facilitate an increase of output, this has been done, in many instances, workmen producing twice as much as they would on a similar job in this country with about half the physical effort.

Where it was not possible to introduce machinery to the fullest extent (and this applies very much to the general moulder on jobbing work), the method adopted was that productive men were kept entirely on productive work. They were not allowed to expend their energy and strength on work which could be done by unskilled men.

I was continually being informed that no machine was considered the "last word." In all the works I visited experiments are continually being made. Workmen of all grades are encouraged to make suggestions for improvement; the machines now working will be ruthlessly scrapped if something better is found.

It is realised that only by methods such as these can high production, high wages, and high consumption be maintained. The workmen on their part seem to be convinced that to maintain high wages they must maintain high production, and they seemed to be just as ready to talk of the high productive methods as were the employers.

The feeling between employers and workmen appeared excellent. A feeling of confidence in each other, which is sadly lacking in the old country, was evident everywhere. I proved this not only in the works, but by contact with men outside.

The greatest possible attention is paid to welfare. Splendid canteens where meals could be purchased and eaten under conditions of absolute cleanliness were met with everywhere. Fountains of *running* drinking water were to be found in every workshop. Washing and shower baths were provided at every foundry I visited. Lockers were available for every workman. Thus on arrival he could put on his work garb, lock up his outdoor clothing in his own locker away from the dust and dirt of the shop, and at the end of the day after a wash and a complete change go home like a respectable citizen not ashamed to take a seat in any company in motor-car, train or tramway-car. In this latter connection it is an undoubted fact that a big proportion of American workmen go to and from work in their own motor-cars, and the huge "parks" for cars outside the works during working hours are a revelation to the visitor.

Retiring Pensions.

All the big works have their own hospitals fitted with all the latest surgical and medical appliances. A resident doctor is on the spot to attend to every injury, slight or serious, that may happen in the works. Primarily, this is for the good of the injured person, but it also has as an object the reduction of lost time to an absolute minimum. Serious accidents are not very frequent as American employers have made almost a fetish of "Safety First." There is the keenest possible competition between departments as to which can be run with the fewest accidents of any kind, and charts are posted in all parts of the works showing results in this direction. Most American employers run schemes, some contributory, some non-contributory, insuring against sickness or death. In some cases 5 per cent. of the workman's annual earnings are given to him as a bonus at six-monthly or yearly intervals. In nearly every plant I visited a minimum of from two to five years' service guaranteed a week's holiday annually with pay and ten to twenty years' service, two weeks with pay. Very long service is rewarded with a retiring pension based on the highest earnings during several years prior to retirement. This phase of industrial life is very important in the United States, for the percentage of long service men in most of the plants visited is very high. Employees are everywhere encouraged to purchase shares in the company which employs them. The means of purchase are generally made easy and attractive and that the idea is popular and taken advantage of is proved by the fact that in some of the works visited 100 per cent. of the employees are shareholders, and in no case where the system was in operation was the percentage less than 15.

This consideration for the welfare and future of their employees is regarded by American employers as being necessary for the successful carrying on of their business. They claim that it encourages workmen to stop with one firm and they attach the greatest importance to this, holding that changes and constant turnover of labour are bad for industry.

On the other hand, the trade union point of view is that these schemes were introduced and are maintained to kill any desire on the part of men to join trade unions. If this latter contention is correct, the American employers have been fairly successful, for trade unionism in the engineering industry in the United States is in a bad way. Without expressing a definite opinion on the subject, it can be safely said that most of the workmen seem to be doing well. It may be added that schemes like these can only be operated in large works or plants, and in this connection it is well to remember that 87½ per cent. of the business of the United States is in the hands of large companies.

Bonus Schemes.

Workshop committees exist in most plants, and whilst these seem to have nothing to do with the fixing of prices, they seem to be highly satisfactory to all concerned and to work very well. In connection with prices, I was surprised to find how very little straight piece-work was in operation. Several large employers stated frankly that they did not believe in it. Bonus schemes of various sorts are almost universally in operation, based as a rule on the time taken on a job. A very important fact in this connection was the assurance given by every employer we met that prices were never cut unless a change in operation took place. No matter what a workman earned, his rates were never interfered with. This statement was also endorsed by workmen with whom I discussed the question.

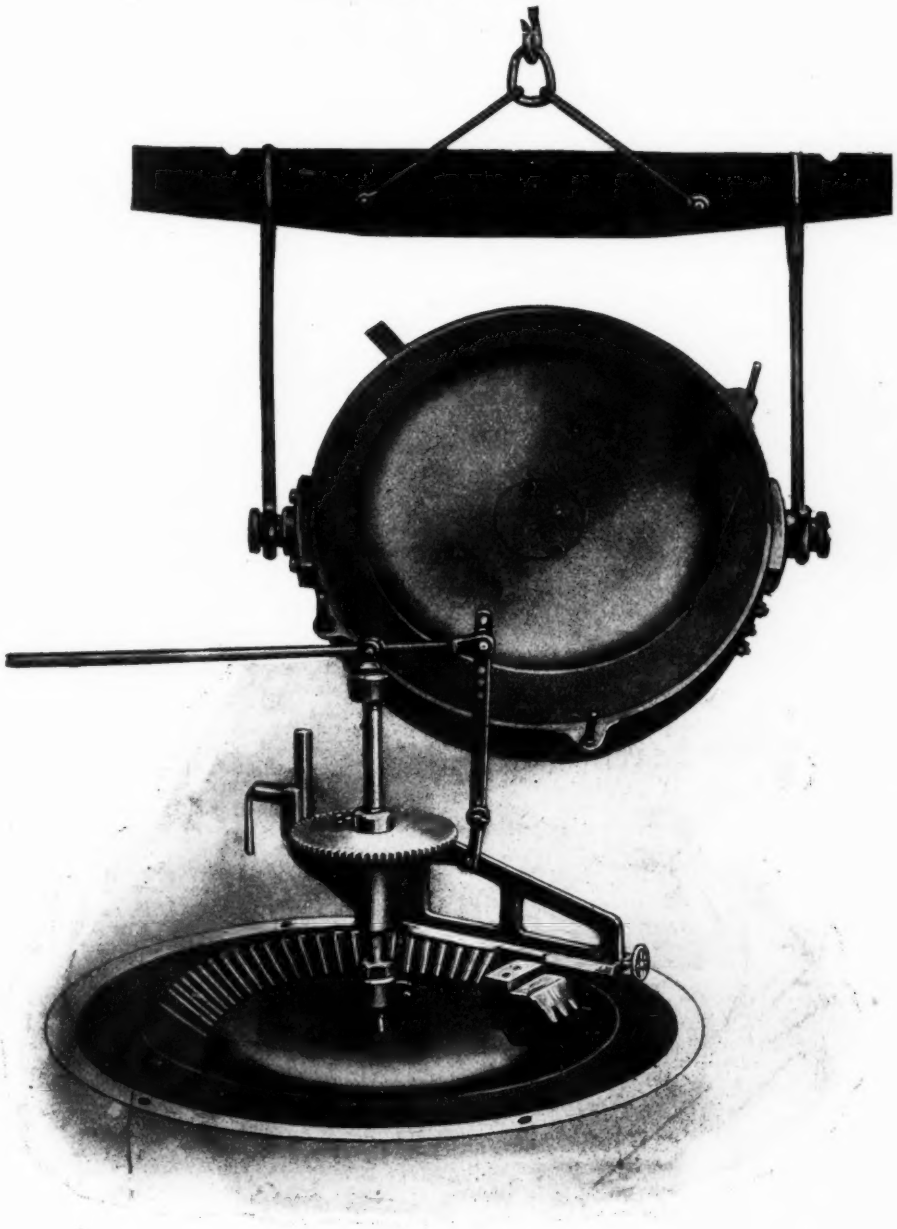
It will be readily seen that the incentive to give of his best without fear of a cut in his wages is the finest thing that can happen to a workman on productive work. It should also be stated that in their anxiety to retain the services of skilful workmen, employers protect them to such an extent that none can be dismissed

Continued on page 362.

* Price 2d. from all bookstalls.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

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Continued from page 360.

unless for grave misdemeanour and then only by the works superintendent.

A few details of some American foundries are appended.

Neptune Meter Plant, New York.—This was a brass foundry engaged on purely repetition work. The system was day work, a given number of boxes constituting a day's work. Earnings averaged £9 per week of 48 hours. In addition, bonus is paid to men out of a fund set aside each year by the firm. One half of the fund is devoted to experimenting with labour-saving devices and the other half is paid to the workman. Last year's bonus amounted to 8 per cent.

General Electric Plant, Schenectady.—An outstanding feature in this shop which employs several hundred moulders in iron, steel, and brass is that, in spite of the fact that the class of work is very large, there is little or no loam moulding. In fact, during the whole tour, I do not remember seeing a loam moulder at work. The wages vary from £7 10s. to £10 per week of 48 hours, according to class of work. The foreman is a native of Rochdale and has been with the company for many years.

American Locomotive Works, Schenectady.—The feature here is that nearly all the work, cylinders included, is done on machines, semi-skilled men ramming-up and moulders finishing and coreing the moulds. Wages vary from £7 to £10 per week for a 50-hour week. The General Manager is a Scot.

Standard Foundry, Detroit.—In this foundry, which is engaged on repetition work, the circular conveyor system of carrying boxes away from the moulder is in operation. Wages vary from £8 to £9 per week of 48 hours.

Organisation and Specialisation.

Several foundries engaged on production of motor castings were visited, including those of the Packard, Cadillac, Buick, Chevrolet and Ford plants. Hundreds of moulders and coremakers are engaged in these works on mass production and the output due to the wonderful organisation and specialisation is almost staggering. They also employ many moulders on general work for the maintenance of plant and experimental work. These men are invariably on day work at rates varying from £7 10s. to £9 per week of 48 and 50 hours. In one of these foundries I met an old friend, R. H. Bennett, a former secretary of the Camborne branch of my Society. There are also several Britishers employed as overseers to the machinemen in the production shops.

The Gary Steel Plant.—Here in a foundry for maintenance work, in connection with this great steel plant, 200 moulders are employed on day work, 50 being engaged on rolls for the production of steel rails. The wages average £8 per week of 60 hours.

The Crane Plant, Chicago.—This is a large plant making valves, pipes and steam fittings on mass production. Casting goes on all day. Wages vary from £7 to £9 per week of 49 hours. Girl coremakers are employed here making cores from machines. They earn from £5 to £7 per week. In addition, all employees receive a 5 per cent. bonus on their annual earnings.

The Baltimore and Ohio Railroad Shop, Baltimore.—This shop was visited at the request of the American Federation of Labour. Fifty moulders are engaged on day work, the wages being £7 5s. per week of 48 hours.

Mesta Machine Plant, Pittsburg.—Here the foundry specialises in mill and forge work in iron and steel. The men are on day work with a bonus system which brings wages to an average of £10 per week of 54 hours. A feature at this plant is the production of rolls and pinions by the drop forge process. Some of these rolls are several tons in weight and were a revelation to me as I was under the impression that all this class of work was cast. As a matter of fact the development of drop forgings has proceeded to a wonderful extent in the United States. At the International Harvester Plant at Chicago a stage has been reached at which the daily output of forgings, large and small, exceeds that of castings. This again is a development which the foundryman must consider for it is all lost work to the moulder. One large employer informed me that he thought *iron* moulding would soon be a thing of the past in the United States due to the development of forgings and steel castings. Several other foundries were visited in Pittsburg, but there were no outstanding features except the wages, which average about £10 per week of from 48 to 60 hours.

The Cincinnati Milling Machine Plant.—Here all castings, large and small, are produced by machine moulding and skilled moulders are only engaged in coreing and closing. Wages vary from £8 to £10 per week of from 48 to 50 hours. This also applies to the other great machine tool factories in Cincinnati, and after seeing them it is no wonder to me that our shops are flooded with American Machine Tools whilst our own trade is stagnant. Our guide at Cincinnati was Mr. J. Wilson, member of the Executive Council of the American Federation of Labour and President of the American Patternmakers organisation.

Manual Labour Lessened.

I do not suggest for a moment that the United States is a paradise for moulders. They have to work hard, but they get a better return for their work and their actual manual labour is lessened wherever possible to the mutual advantage of the moulder and his employer.

Nor do I suggest that the American employer is a philanthropist. He does not pose as one. He will tell you quite frankly that he is not in business for his health.

But I do think that in America the moulder and his employer understand each other better than is the case in our country. This better understanding works out to the great personal benefit of both employer and employee, and the industrial prosperity of the whole American nation is thereby increased.

I was assured by all American employers that there is the greatest difficulty in times of good trade in getting skilled moulders. Whenever I went into a shop, I had only to look round for the best job—the most intricate and the one requiring the most skill—and in 75 per cent. of cases the moulder or moulders came from Europe, chiefly from Britain.

No apprentice moulders are being trained in the United States. Throughout my tour I never saw one. Some employers are quite frank and state that they depend for their supply of moulders on Great Britain. This should surely spur our own employers to give us better conditions and prospects, for it is a well-known fact that the supply of apprentices in the foundries of Britain is rapidly diminishing. If the American employer is going to drain the foundries of our most skilful moulders by the better prospects he offers, the future of the engineering industry in Britain will be seriously handicapped.

It is my firm belief that the moulder in the United States works no harder and in some cases not so hard as moulders do in Britain. He, however, certainly produces more, but this is due to the introduction of machinery and labour-saving devices and the keeping of productive men on productive work. One instance of this latter is that the moulder who has to knock his own work out or to clear up a floor is the exception in the United States. Night gangs of labourers are employed in most big shops to clear up the place ready for a clean start by the moulder. In other cases the shop is cleared after the moulder has gone home.

My report on foundry conditions in the United States cannot be finished without some reference to the coloured men who are employed in large numbers in American foundries. This class of labour would seem to give the American employer a decided advantage over his competitors. Almost all the foundry labourers and machine moulders I saw at work were coloured men.

In conclusion I repeat that, as compared with his fellow craftsman in Britain, the American moulder enjoys a much higher standard of life both at home and at work. Furthermore, when he has budgeted for all his expenses he has a nice saving margin left which enables him to make the trips home to the old country which seem to be the ambition of every Briton in the United States.

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Effect of the General Strike on the Foundry Trade.

DERBYSHIRE.

In regard to the position of the foundry industry in Derbyshire during the strike, the following notes may be of interest:—"Ley's" have carried on throughout the whole period of the strike, and have not had a single man absent from duty; in fact, the company feel quite proud of their record during the crisis. As their business is run as a profit-sharing concern, it clearly shows that when the employees have a direct interest in the business, there is not the friction or trouble or any reason for them to use arbitrary methods to achieve their own ends. There were attempts made to induce the men to cease work by a picketing meeting, etc., at which the men attended, but with no results. Many of the foundries in the area were closed, as the men were called out, but the fact remains that Derbyshire has a fine record, as there was scarcely any disturbance whatever during the strike.

SHEFFIELD.

The position at the works is remarkably good, excepting where the supply of fuel entered into the question. Most works started off at full pressure, and with every man wanted returning to his job. The difficulty was to judge how long this state of affairs would continue, as nothing could be sent away by railway, nor could the foundries get delivery of any raw materials by this means. The position in regard to foundry coke may yet be serious unless it so happens that makers have abundant stocks. As far as we can ascertain the men are genuinely glad to be back at work once more, and they hold a very poor opinion indeed of the would-be autocrats who called the general strike. The calling out of the labourers and crane men met with a moderate response, but there were plenty left to carry on successfully. Unfortunately few, if any, new orders are being given out, and even if the coal dispute is settled quickly, most foundries round here will require many new orders to keep going on even a 50 per cent. basis. Progress is being made with the arrangements for the convention to be held in Sheffield next year. A strong committee has been formed, with Mr. Macdonald as secretary, and there is a strong desire to make the conference equal to any so far.

NORTHUMBERLAND and DURHAM.

The men were out for one day when the general strike was called off. As it happened, many firms were just about out of pig-iron and scrap, so that it really did not matter. We expect that it will be about a week or more before many foundries can get fully started. In the meantime some are running about 20 per cent. of their men, and just melting occasionally. Some of the foundries lower down the river were fortunate inasmuch as their men refused to come out on strike, and it is fully expected that these foundries will be in a position to carry on until further supplies of raw material are available. In the majority of cases the foundry owners have been carrying on with maintenance work, and generally getting the places straightened up.

THE MIDLANDS.

The foundries round this district have been carrying on in a normal way. Their main difficulty has been transport, and this is still very much in evidence in the Birmingham area, and there is very little movement in the goods traffic up to the present. It would appear that the railway companies are not likely to get their goods trains organised until the settlement of the coal question, as a great deal of the traffic is in connection with the transport of coal and coke.

OXFORD DISTRICT.

Acting on Mr. Baldwin's advice all the foundries carried on as usual. The "Morris-Oxford Mail" was published as occasion and supply of news permitted to bridge the gap caused by the closing down of the national Press. There were no disturbances of any description. Meetings were held outside some of the local foundries in an endeavour to get the workers to come out, but the men refused to give their support.

SCOTLAND.

There was no general stoppage of work at Scottish foundries. There was a certain amount of unsettledness for a day or two in some of the shops, and rumours of stopping, but, eventually instructions were to continue work. One or two firms in Falkirk found themselves short of fuel, and after stopping for a day or so had this remedied and resumed. So far as we know none of the foundries in Scotland, except those mentioned, stopped work during the strike, although most of them cut down output to castings which were on order.

Patent Specifications Accepted.

The following list of patent specifications accepted have been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full specification can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

The last numbers in each case are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

11,080 Brumm, E. Process and apparatus for the casting of melted metals under pressure. (May 1, 1924.) 233,343.

13,935. General Electric Company, Limited. Process for the manufacture of thin sheets of tungsten, tantalum, molybdenum, and other refractory metals. (February 11, 1925.) 247,507.

20,293. Soldat, J. Foundry moulding-machine. August 12, 1925. 249,396.

23,849. Flodin, H. G., and Gustafsson, E. G. T. Production of iron or steel alloys. (September 24, 1924.) 240,473.

26,716. Mannesmannrohren-Werke. Rolling-mill for rolling tubes. (October 27, 1924.) 241,950.

27,179. Worthy, T. W. Means for securing buckets to rope grips of aerial ropeways. November 14, 1924. 246,603.

27,682. British Thomson-Houston Company, Limited, and Griffiths, L. Shaft couplings. November 19, 1924. 246,613.

26,463. Breeden, F., Breeden, F. V., and Kirk, T. Making of patterns for use in the production of moulds or matrices for casting purposes. November 6, 1924. 246,597.

28,269. Johannsen, F. Treatment of ores and metallurgical products. December 7, 1923. 225,842.

28,271. Downing, J. F. Moulding and casting of metal bodies. November 25, 1924. 246,620.

29,215. Talbot, B. Metallurgical furnaces. December 5, 1924. 246,627.

29,216. Talbot, B. Metallurgical furnaces. December 5, 1924. 246,628.

4,639. Lowndes, E. C. Reverberatory furnaces. February 19, 1925. 246,681.

18,727. Haddon, W., and Fullilove, J. A. Machine for casting boxes and other hollow metal articles. August 6, 1924. 246,881.

26,903. Vanderstein, E. Cupola furnaces with hot blast apparatus. November 11, 1924. 246,932.

30,102. Hume, W. R. Manufacture of pipes and the like from metal sheets or plates. December 15, 1924. 246,967.

510. Pneumatic Engineering Appliances Company, Limited, and Hines, L. H. Foundry moulding-machines. January 7, 1925. 246,988.

10,685 Askania-Werke Akt.-Ges. Vorm. Centralwerkstatt-Dessau und C. Bamberg-Friedenau. Gas-fired furnaces. May 31, 1924. 234,791.

16,515. Coslett, T. W. Processes for the treatment of iron or steel for preventing oxidation or rusting. June 26, 1925. 247,071.

18,211. Reiser, H. Furnaces. July 16, 1925. 247,083.

26,385. Leveque, P. Furnaces. October 22, 1924. 241,916.

1,167. Haddon, W., and Fullilove, J. A. Mould for casting boxes and other hollow metal articles. August 6, 1924. Divided Application on 246,881. 247,133.

26,844. James, R. W. (Eisenwerk-Ges. Maximilianshutte). Process for the production of high tensile steel. November 11, 1924. 247,276.

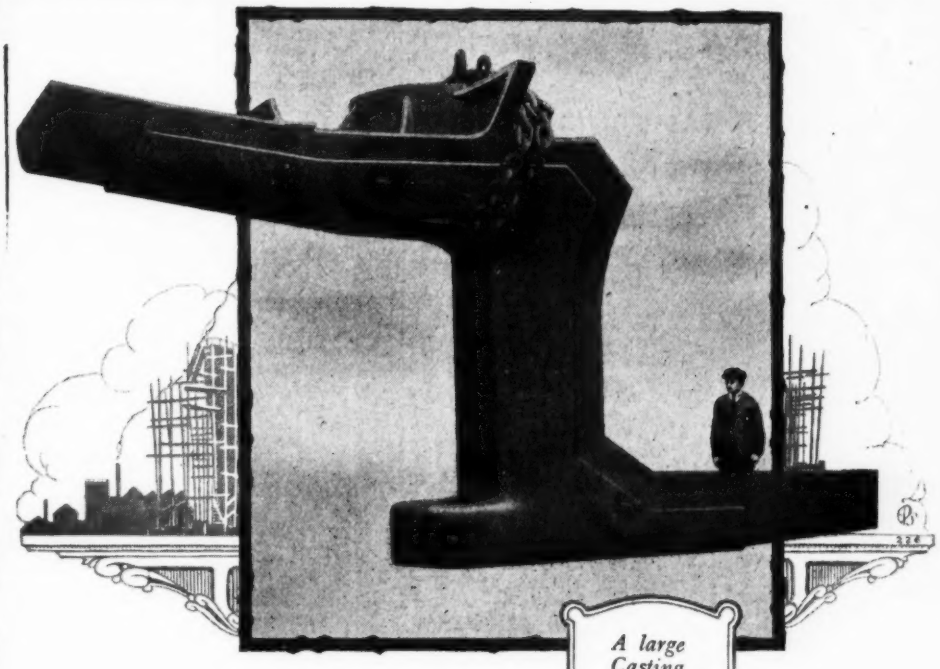
26,888. Reed, S. A. Machine for twisting metal plates. November 11, 1924. 247,278.

15,614. White, A. E. (Morgan Construction Company). Method of and apparatus for cooling and annealing metal bars. June 16, 1925. 247,447.

18,753. Pritchard, P., and Pneulec Machine Company, Limited. Liquid-fuel burners for use with furnaces. July 23, 1925. 247,462.

ARMSTRONG·WHITWORTH

SHIPS
MARINE ENGINES
LOCOMOTIVES
MACHINE TOOLS
FORGINGS CASTINGS
NON FERROUS PRODUCTS
DROP STAMPINGS
HIGH SPEED STEELS
SMALL TOOLS GAUGES
PNEUMATIC TOOLS
ELECTRIC LIGHTING SETS
ROAD MAKING MACHINERY
HYDRAULIC MACHINERY
HYDRO ELECTRIC PLANT
CIVIL ENGINEERING
GENERAL ENGINEERING



A large Casting weighing over 40 Tons.

CASTINGS

OUR FOUNDRIES are equipped with the most up-to-date plant for the production of fine castings.

They are under the supervision of expert metallurgists, and castings are guaranteed of British Standard or other specifications to customers' requirements.

The foundries work in close co-operation with our extensive machine shops.

We invite your enquiries for Iron and Steel Castings, rough or finished machined.

SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD.
Works: OPENSHAW and GATESHEAD.
London Office: 8, GREAT GEORGE STREET, WESTMINSTER, S.W.1.
Telephone: Victoria 4010 (6 lines). *Code: Bentley's.* *Telegrams: "Zigzag, Parl, London."*

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	56	7	6
Three months ..	57	5	0
Electrolytic	64	5	0
Tough	59	15	0
Best selected ..	60	5	0
Sheets	90	0	0
India	74	0	0
Wire bars	65	0	0
Do. May	64	10	0
Do. June	64	10	0
Ingot bars	64	10	0
H.C. wire rods ..	69	0	0
Off. av. cash, Apr.	57	5	2¼
Do., 3 mths. Apr.	58	2	3
Do., Sttlmnt, Apr.	57	5	0
Do., Electro, Apr.	64	16	7½
Do., B.S., Apr. ..	61	1	4⅝
Aver. spot price copper, Apr. ..	57	5	0
Do., wire bars, Apr.	65	1	3
Solid drawn tubes		12½d.	
Brazed tubes ..		12¾d.	
Wire		9½d.	

BRASS.

Solid drawn tubes ..	11¾d.
Brazed tubes	13½d.
Rods, drawn	10¾d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	9¾d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

Standard cash ..	268	0	0
Three months ..	265	0	0
English	265	15	0
Bars	268	10	0
Straits	276	10	0
Australian	269	10	0
Eastern	271	10	0
Banca	269	10	0
Off. aver. cash, Apr.	281	10	6
Do., 3 mths., Apr.	271	0	10½
Do., Sttlmt. Apr.	281	9	9
Aver. spot., Apr.	281	9	9

SPELTER.

Ordinary	32	2	6
Remelted	32	5	0
Hard	26	15	0
Electro 99.9 ..	35	15	0
English	32	15	0
India	29	5	0
Zinc dust	42	0	0
Zinc ashes	14	0	0
Off. aver., Apr. ..	32	13	7⅞
Aver., spot, Apr.	32	10	0¾

LEAD.

Soft foreign ppt.	28	7	6
English	30	0	0
Off. average, Apr.	29	0	7⅛
Average spot, Apr.	28	15	6

ZINC SHEETS, &c.

Zinc sheets, English	41	0	0
Do. V.M. ex whf.	38	10	0
Rods	44	0	0
Boiler plates ..	38	10	0
Battery plates ..	38	0	0

ANTIMONY.

Special brands, Eng.	89	10	0
Chinese	70	0	0
Crude	45	0	0

QUICKSILVER.

Quicksilver ..	15	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 10 0
45/50%	11 5 0
75%	20 0 0
Ferro-vanadium—	
35/40%	14/6 to 15/- lb. va.
Ferro-molybdenum—	
70/75% c. free	6/3 lb.
Ferro-titanium—	
23/25% carbonless	11½d. lb.
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%, c.fr. ..	1/7¾ lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car. ..	£33 10 0
4/6% car. ..	£22 5 0
6/8% car. ..	£21 15 0
8/10% car. ..	£20 17 6
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£43 10 0
Max. 0.70% car.	£54 10 0
70%, carbonless	1/5½ lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£112
Metallic Chromium—	
96/98% ..	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 0 0
76/80%, packed	£16 0 0
76/80%, export	£14 5 0
Metallic manganese—	
94/96%, carbonless	2/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten ..	s. d. 2 6
Finished bars, 18% tungsten ..	3 0
Per lb. net, d/d buyers' works.	
Extras—	
Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do. under ½ in. × ¼ in.	1/- lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel—	
Scrap pieces	3d.
Turnings and swarf	1d.
Per lb. net, d/d steel makers' works.	

SCRAP.

South Wales—	£	s.	d.	£	s. d.
Hvy. steel	3	7	6 to	3	10 0
Bundled steel & shrngs.	3	3	0 to	3	6 0
Mixed iron & steel	3	0	0 to	3	2 6
Heavy cast iron	3	2	6 to	3	5 0
Good machinery for foundries ..		3	7	6	
Cleveland—					
Heavy steel	3	1	to 3	2	0
Steel turnings ..		2	5	0	
Cast iron borings		2	4	0	
Heavy forge ..		4	0	0	
Bushelled scrap		3	7	6	
Cast-iron scrap		3	5	0	
Lancashire—					
Cast-iron scrap	3	5	to 3	10	0
Hvy. wrought ..		3	5	0	
Steel turnings ..		2	2	0	
London — Merchants' buying prices delivered yard.					
Copper (clean)..		49	0	0	
Brass (clean) ..		38	0	0	
Lead (less usual draft)		25	10	0	
Tea lead ..		21	0	0	
Zinc		24	0	0	
New aluminium cuttings ..		80	0	0	
Brazierv copper		45	0	0	
Gunmetal ..		44	0	0	
Hollow pewter		176	0	0	
Shaped black pewter ..		130	0	0	

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	75/-
Foundry No. 3 ..	72/6
Foundry No. 4 ..	71/6
Forge No. 4	70/6
Hematite No. 1 ..	76/6
Hematite M/Nos. ..	76/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	85/3
,, d/d Birm.	93/-
Midlands—	
Staffs common* ..	—
,, No. 4 forge ..	62/6
,, No. 3 foundry	67/6
Shrops. basic	70/-
,, Cold blast, ord.*	185/-
,, ,, roll iron* ..	190/-
* d/d Birmingham.	
Northants forge	56/6
,, fdry No. 3 ..	63/3
Derbyshire forge ..	60/6
,, fdry. No. 3 ..	67/3
,, basic	65/-
Scotland—	
Foundry No. 1 ..	81/-
,, No. 3 ..	76/-
Hem. M/Nos.	76/-
Sheffield (d/d district)—	
Derby forge	65/-
,, fdry. No. 3 ..	71/6
Lincs. forge	67/6
,, fdry. No. 3 ..	70/-
E.C. hematite	87/-
W.C. hematite ..	89/-
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3.. ..	64/-
Basic	63/-
Lancashire (d/d eq. Man.)—	
Derby forge	68/-
,, fdry. No. 2 ..	75/3
Northants foundry No. 3	76/-
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	93/6
Glengarnock, No. 3 ..	93/6
Gartsherrie, No. 3 ..	93/6
Monkland No. 3	93/6
Coltness, No. 3	93/6
Shotts, No. 3	93/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	0	0 to	12	0	0
Angles		11	10	0		
Tees to 3 united ins.		12	0	0		
Nut and bolt	10	5	0 to	10	7	6
Hoops	14	0	0 to	15	0	0
Marked bars (Staffs.) f.o.t. ..		14	0	0		
Gas strip		12	10	0		
Bolts and nuts ¾ in. × 4 in. ..		15	5	0		
Steel—						
Ship plates	7	12	6 to	7	17	6
Boiler plts. ..		11	5	0		
Chequer plts. ..		9	15	0		
Angles		£7	2	6		
Tees		£8	2	6		
Joists		£7	2	6		
Rounds and Squares 3 in. to 5½ ins. ..		7	15	0		
Rounds under 3 in. to ⅜ in.		7	10	0		
Flats, over 5 in. wide and up ..		8	5	0		
Flats, 5in. to 1½in.		7	5	0		
Rails, heavy ..		8	0	0		
Fishplates		12	0	0		
Hoops (Staffs.) ..		10	10	0		
Black sheets, 24g.		11	2	6		
Galv. cor. sheets, 24g.	15	5	0 to	15	10	0
Galv. fencing wire 8g. plain		13	0	0		
Billets, soft	£6	2	6 to	6	5	0
Billets, hard	—	8	2	6		
Sheet bars	6	0	0 to	6	2	6
Tin bars d/d	6	2	6 to	6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3¾
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.26
No. 2 foundry, Valley	20.76
No. 2 foundry, Birm.	22.00
Basic	20.26
Bessemer	21.26
Malleable	20.76
Grey forge	20.26
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.25
Sheets, galv., No. 28 ..	4.50
Sheets, blue an'l'd, 9 & 10	2.40
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb box	$5.50

COKE (at ovens).

Welsh foundry ..	32/6 to 40/-
,, furnace ..	20/- to 25/-
Durham & North.	
,, foundry	30/- to 33/-
,, furnace ..	14/6
Other Districts, foundry	30/- to 33/-
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/1½
,,	28×20, ,,	38/3
,,	20×10, ,,	28/10½
,,	18¾×14, ,,	20/1½
C.W.	20×14, ,,	17/1½
,,	28×20, ,,	34/7½
,,	20×10, ,,	23/9
,,	18¾×14, ,,	18/1½

Terneplates 28×20, 35/6 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/15/0 to £16/5/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 5 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60%	.. 50%
Water ..	55%	.. 45%
Steam ..	50%	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.		
May 13	56	12	6	dec.	5/–
,, 14	56	17	6	inc.	5/–
,, 17	56	15	0	dec.	2/6
,, 18	56	10	0	,,	5/–
,, 19	56	7	6	,,	2/6

Electrolytic Copper.

	£	s.	d.		
May 13	64	10	0	No change	
,, 14	64	15	0	inc.	5/–
,, 17	64	15	0	No change	
,, 18	64	10	0	dec.	5/–
,, 19	64	5	0	,,	5/–

Standard Tin (Cash).

	£	s.	d.		
May 13	274	5	0	dec.	30/–
,, 14	273	10	0	,,	15/–
,, 17	271	5	0	,,	45/–
,, 18	268	15	0	,,	50/–
,, 19	268	0	0	,,	15/–

Tin (English ingots).

	£	s.	d.		
May 13	272	0	0	dec.	40/–
,, 14	271	10	0	,,	10/–
,, 17	269	0	0	,,	50/–
,, 18	266	10	0	,,	50/–
,, 19	265	15	0	,,	15/–

Zinc Sheets (English).

	£	s.	d.		
May 13	41	0	0	No change	
,, 14	41	0	0	,,	,,
,, 17	41	0	0	,,	,,
,, 18	41	0	0	,,	,,
,, 19	41	0	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
May 13	32	0	0	inc.	1/3
,, 14	32	5	0	,,	5/–
,, 17	32	8	9	,,	3/9
,, 18	32	3	9	dec.	5/–
,, 19	32	2	6	,,	1/3

Lead (English).

	£	s.	d.		
May 13	29	15	0	No change	
,, 14	30	0	0	inc.	5/–
,, 17	30	5	0	,,	5/–
,, 18	30	5	0	No change	
,, 19	30	0	0	dec.	5/–

AVERAGE MONTHLY PRICES OF SIEMENS TINPLATE BARS (S. WALES).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	4 0 0	4 0 0	3 18 0	3 18 0	3 18 0	3 18 0	4 2 6	4 7 6	4 7 6	4 10 0	4 7 6	4 7 6	4 2 1
1897	4 10 0	4 12 9	4 10 0	4 7 6	4 7 0	4 2 6	4 2 6	4 2 6	4 2 6	4 0 0	4 2 6	4 2 6	4 5 2½
1898	4 2 6	4 2 6	4 2 6	4 2 6	4 10 0	4 10 0	4 10 0	4 10 0	4 10 0	4 10 0	4 12 6	4 12 6	4 7 11
1899	4 15 0	4 15 0	4 12 6	4 12 6	4 15 0	4 17 6	5 15 0	6 2 6	6 5 0	6 7 6	6 7 6	6 12 6	5 9 11
1900	7 2 6	7 7 6	7 7 6	7 10 0	7 7 6	7 7 6	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	5 7 6	7 1 3
1901	5 5 0	5 5 0	5 5 0	4 17 6	4 15 0	5 0 0	5 2 6	5 2 6	5 5 0	5 2 6	5 2 6	5 0 0	5 1 10½
1902	4 17 6	5 0 0	5 5 0	5 5 0	5 5 0	5 5 0	5 2 6	5 2 6	4 17 6	4 17 6	4 15 0	4 15 0	5 0 7
1903	4 15 0	4 15 0	4 15 0	4 15 0	4 17 6	4 17 6	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 7 6	4 14 7
1904	4 7 6	4 7 6	4 7 6	4 7 6	4 12 6	4 12 6	4 7 6	4 7 6	4 7 6	4 5 0	4 5 0	4 5 0	4 7 2½
1905	4 7 6	4 8 9	4 7 6	4 7 6	4 7 6	4 10 0	4 6 6	4 6 6	4 7 6	4 10 0	5 0 0	5 0 0	4 8 3
1906	5 5 0	5 5 0	5 2 6	4 17 6	4 17 6	5 0 0	5 0 0	5 0 0	5 0 0	5 2 6	5 7 6	5 17 6	5 2 11
1907	5 17 6	6 0 0	6 0 0	6 2 6	6 2 6	6 5 0	6 5 0	6 5 0	6 5 0	5 17 6	5 12 6	5 5 0	5 19 7
1908	5 0 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 6	4 10 0	4 7 6	4 7 6	4 10 0	4 8 9	4 10 0	4 11 3
1909	4 10 0	4 8 9	4 7 6	4 7 6	4 7 6	4 8 9	4 10 0	4 8 9	4 10 0	4 12 6	4 13 9	4 15 0	4 10 0
1910	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6	5 2 6
1911	5 3 9	5 5 0	5 4 6	5 1 10	5 0 0	5 0 0	5 0 0	5 0 0	5 0 0	4 18 9	4 17 6	4 18 9	5 0 10
1912	5 1 3	5 2 6	5 5 0	5 5 0	5 10 0	5 11 10	5 14 4	5 15 0	5 15 7	5 17 6	5 17 6	5 17 6	5 11 1
1913	5 17 6	5 17 6	5 12 6	5 12 6	5 9 6	5 5 0	5 5 0	4 16 3	4 16 3	4 16 3	4 16 3	4 11 3	5 5 3
1914	4 11 3	4 11 3	4 11 3	4 11 3	4 11 3	4 11 3	4 11 3	4 16 3	5 2 6	4 19 6	4 15 0	4 15 0	4 13 11
1915	5 4 3	6 5 0	6 15 0	7 5 6	7 9 4½	7 7 2	7 6 0	7 4 8	7 1 10½	7 4 0	8 15 0	0 12 6	7 7 7
1916	11 6 10½	11 14 4½	12 7 0	11 3 1½	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 15 11½
1917	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6
1918	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6	10 7 6
1919	10 10 6	11 12 6	12 5 0	12 5 0	13 10 0	13 9 4½	13 10 7½	14 0 0	14 4 0	15 2 6	16 3 1	13 7 8½	
1920	18 15 0	25 5 0	31 0 0	30 15 0	30 5 0	30 0 0	25 10 0	23 10 0	23 0 0	20 15 0	18 5 0	18 0 0	24 13 4
1921	17 10 0	15 5 0	14 10 0	13 0 0	12 5 0	11 10 0	10 6 0	8 15 0	8 10 0	8 5 0	7 15 0	17 15 0	11 5 6
1922	7 9 4½	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 5 7½	7 3 9	7 9 1½	7 7 2½
1923	7 17 3½	8 3 6	8 18 9½	10 0 0	9 9 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	9 1 0	8 18 9	9 0 1½
1924	8 18 9	8 18 9	8 18 9	8 18 9	8 18 9	8 12 6	8 12 6	8 11 7½	8 11 7½	8 12 6	8 11 3	8 7 6	8 14 5½
1925	8 7 6	8 3 3	7 17 6	7 17 6	6 16 10½	6 13 9	6 13 9	6 13 5½	6 10 11½	6 8 0	6 15 0	6 5 0	7 1 10½
1926	6 4 8½	6 3 9	6 3 9	6 3 9	—	—	—	—	—	—	—	—	—

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